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SOIL EROSION

BY

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In an address upon agricultural development in the tropics, which was given at the annual meeting of the Empire Cotton Growing Corporation in 1929, I referred to the importance of the subject of soil erosion. Attention was drawn to this in the EMPIRE COTTON GROWING REVIEW for October, 1929, and I have now been asked to contribute a short article summarizing the efforts which have been made in the Empire during the past five years to deal with this problem.

In the address mentioned above, I referred to conditions obtaining in Ceylon, where for a number of years endeavours had been made by the Department of Agriculture to arouse public opinion as to the seriousness of soil erosion in that Colony, and to the need for the adoption of protective measures. To any visitor to Ceylon during the monsoon rains, the waters in the rivers present ample evidence of the amount of soil which is annually lost. From 1873 onwards the attention of the Government had been constantly drawn to the losses which were being continuously incurred from soil erosion, and in several reports the seriousness of the problem was emphasized. Numerous recommendations for dealing with it were made, but few, if any, of these recommendations were adopted.

It had not been sufficiently realized in Ceylon that, as has been so aptly put recently by General Smuts in connection with a soil erosion campaign in the Union of South Africa, " there is only one solution, and that is the *education* of public opinion." South Africa today has vast areas of mountainsides which are bare rock, their overlying soil having been washed out to the sea. With the loss of this overlying soil, floods have become more severe. Legislation can effect some improvement in the control of soil erosion, but it is likely to be insufficient because any law is effective only when the people of the country concerned are in the state of mind to carry

out that law. The Union of South Africa has been fully aroused to the fact that there must be insurance for the future, that a policy must be evolved to protect the interests of the country as a whole, and that no more constructive avenue of employment could be found for unemployed persons than the utilization of their services on reclamation work as part of a soil erosion campaign subsidized by the State.

Little real interest was taken in the question in Ceylon until about 1923, when a determined effort was made to arouse public and "planting" interest. Visitors to Java had been impressed by the steps which were being taken in that country to preserve its soils from erosion, and the propaganda campaign which was then started met with a ready response from all classes of agriculturists. A Committee on Soil Erosion which reported early in 1931 stated that the successful propaganda work which had been done by the Department of Agriculture had been fruitful in stimulating agricultural interest in soil erosion, and in leading tea and rubber plantations to experiment in the use of cover crops, in new methods of opening land, and in modifying drainage systems. This Committee visited all parts of Ceylon and reported that a marked change in agricultural methods and outlook had taken place. It felt that the agriculturists of Ceylon were to be congratulated on the useful work of soil conservation which had been effected during the previous five years. It also commended the Department of Agriculture for the investigational and research work which it had undertaken, and suggested that the newly-formed research organizations for the tea, rubber, and coconut industries should be asked to regard the problem of soil erosion as of the greatest importance, and to organize systematic investigational work in collaboration with the Department of Agriculture. The depression in the tea and rubber industries during the years following 1931 was, however, responsible for a reduction in the efforts to cope with the problem of soil erosion, but it is to be hoped that now that more prosperous days have returned, estate owners and superintendents will redouble their efforts to control the waste of their capital assets—their soils—and that the Ministry of Lands and Agriculture will take a leading part in the propaganda which is necessary to educate public opinion in a persistent demand for soil erosion control.

The prevention of soil erosion is now recognized as being one of the most important agricultural problems in many parts of the world. The experience of older countries can be relied upon for serious warnings as to its effects, and the valuable lessons which can be

learned from southern European countries should not be overlooked. The deterioration of considerable areas of land in some of the Greek islands where terracing has not been adopted, is apparent, whilst, on the other hand, the elaborate terraces to be found in southern France, Italy, and Sicily command admiration. The care which is devoted to terracing in olive groves and vineyards in Italy is most commendable, and one cannot refrain from wondering what changes in the methods of opening tea and rubber estates on hilly lands in the East would have been made had the pioneers been conversant with the methods used for the preservation of soils in southern Europe.

The wastage of soil which has occurred in the United States of America, and the efforts which are being made to check further loss, are now well known. The example of Japan in its measures for the preservation of soil, forest, and water resources, is being appreciated, and in Java it is provided that forest lands can only be opened in economic crops if adequate contour drains are established and terraces made before planting begins.

During the past few years it has been recognised that the soil erosion problem in any country must receive nation-wide consideration, and special attention is now being given to it in a number of countries in the British Empire. A standing Committee has been set up in Tanganyika—on which the Agricultural, Veterinary, Geological, Forestry, Public Works and Railway Departments are represented—to study the problem of soil erosion and make recommendations as to work which should be undertaken to check its effects. It has as its Chairman the Director of the East African Agricultural Research Station at Amani. In Nyasaland soil erosion is being taken seriously, and sound preventive works have been undertaken there, and also in Southern Rhodesia and Basutoland. The seriousness of the problem in some of the native reserves in Kenya has been recognized, and a careful study of the factors which are responsible has been commenced. In the Seychelles, a scheme for the reafforestation of the hilltops of Mahé, one of the granitic islands with high rainfall, has been sanctioned. In the native reserves of Northern Rhodesia it is also recognized that soil erosion is going to be one of the important agricultural problems of the future, whilst the Union of South Africa has recently launched a campaign to render financial assistance to local authorities and landowners for measures against soil erosion, and to combat it in the native reserves. The estimated cost of the work to be undertaken in the reserves during the next five years is £100,000, and one of the principal objects of this campaign is to ensure the preservation of the

chief watersheds of the principal rivers of the Union. During the first five months of its operation 100 miles of embankments and 200 dams have been constructed in the native reserves.

In cotton-growing areas in Africa, the dangers of soil erosion have been recognized. At the Cotton Experiment Station at Makwapala in Nyasaland, for example, erosion became so serious that three years after its opening it became necessary to ridge-terrace the whole Station. Again, at the Serere Experiment Station in the Eastern Province in Uganda a certain area suffered so severely from sheet erosion that after twenty years little soil was left. The area had been eroded to the sterile subsoil which was practically unproductive. New areas had to be opened for experimental work and a change in the system of agriculture introduced.

In certain areas of Uganda and Tanganyika pressure of population has led the inhabitants of their own volition to apply preventive measures, and cultivation methods are not always responsible for erosion. The greatest damage to be seen in Tanganyika and Kenya is in areas where relatively little cultivation is practised. Areas which are overstocked—and there are many of these in East Africa—suffer severely. In such districts all grazing is eaten down "to the bone," and in many the grasses are torn up by the roots. The whole countryside is not only overgrazed but it is grossly overtrampled, especially during the dry season. This reduces the soil to a powder which is either blown by the wind or washed away with the first rains. As soon as the grasses "spring" after the first rains they are ravenously devoured, and no satisfactory growth of grass takes place to bind together the loose powdery soil and prevent its erosion. Certain native reserves in East Africa are showing the effects of serious damage from overstocking, and the danger to the tribes affected is a real one.

In West Africa the effects of soil erosion are as yet relatively unimportant. Here the farms are still small and cultivation on mounds or ridges is general.

In Northern Rhodesia the traditional native agricultural system was similarly in small farms cut out of the bush, but, with the introduction of ploughs, there has been a piecemeal departure from this system towards an imitation of the European farm. Erosion from small holdings of two to three acres in extent is insignificant, particularly if these are cut out of dense bush in which large numbers of tree-stumps are left, but the loss of soil from ploughed farms of ten to twenty acres in extent, which have been established in open country so as to avoid the cost of stumping, is considerable. In the course of this transition,

ploughing is frequently done up and down the slope, certain traditional crops abandoned, and other recognized native methods of cultivation changed. For example, the growing of finger millet has been abandoned for maize and the greater millets, as the bush areas have been left for the open country. Less groundnuts are being grown, and sweet potatoes instead of being planted on mounds are grown on the flat. The ploughing increases the run-off of water, and there are no tree-stumps to check the flow. There is more run-off in maize cultivations than in those of finger millet, and the departure from growing sweet potatoes on mounds is a mistake. The result of these changes is that soil erosion is becoming more serious, and unless some alteration in the system is effected devastation may result. It is not to be expected that a reversion to the traditional methods of the past will be either practicable or possible, and efforts must be directed towards building up, upon the basis of the now forsaken native methods, a system which will make continuous cultivation possible.

This problem of continuous cultivation without loss of soil fertility is one to which the Department of Agriculture in Nigeria has devoted much energy during the past fifteen years, and the results which have been obtained from systems of green manuring and mixed farming are encouraging. Cultivation on ridges as a counterpart to the traditional cultivation on mounds has been adopted. This checks soil erosion, and soil fertility is being maintained by the use of green manures or cattle manure.

In Tanganyika experiments in terracing and anti-erosion methods have been started in both European and native cultivations in the Moshi and Arusha districts, and contour planting is spreading where ridge cultivations have been started. Drainage works primarily designed to safeguard the railway have also been made to serve the purpose of soil protection.

In Nyasaland various measures against soil erosion have been adopted in the tea cultivations on undulating lands, and for tobacco and cotton lands the establishment of Mangum terraces is becoming general where ploughing is practised. This system is also commonly adopted in Southern Rhodesia. The terraces are broad-based ridge terraces of earth which are made at varying distances apart according to the nature of the soil. For clay soils, the ridge terraces are spaced so that a terrace is built for each vertical fall of 2 feet in the slope of the land, and, in sandy soils, for each vertical fall of 4½ feet. These ridge terraces are not level, but are graded according to the slope of the land. The Mangum terraces have been found to be of

the greatest value, and full particulars of their construction are given in the Nyasaland Department of Agriculture *Bulletin No.* 11 (New Series), 1934.

In Basutoland, soil erosion is being combated by the creation of a number of large shallow reservoirs in which flood waters from the hillsides can be collected. In this way the flow of water is being checked. From these reservoirs water is drawn along contour furrows for irrigation purposes, and the moisture of the soil is increased by seepage.

In the Union of South Africa anti-erosion work consists mainly of making dry stone walls and grass-covered banks along the contours. The work is always started at the top of the catchments. The stone walls have a wide base, and are 2 feet high with a horizontal crest. They are spaced at every 6 feet of vertical drop in the slope. The grass-covered banks are spaced about 100 feet apart, and have openings 10 feet wide in them to prevent breaches. If the banks are required only to deal with the rainfall precipitation on the area concerned, the openings are omitted, and where the banks are continued across natural depressions, their heights are raised and their sections suitably increased. In this way, it is possible for a series of terraces gradually to be built up and a contouring of the land for agricultural purposes effected. Areas which have already been sheet eroded are being fenced and planted with cactus and salt bush. On such lands no grazing is to be permitted until some recovery has been brought about, and when limited grazing can be safely allowed, it is proposed to restrict for a while such grazing to one-third of the area and to permit it only from the time when the grasses have flowered and set seed up to the onset of the first rains.

I have endeavoured in the preceding paragraphs to give some account of the steps which are being taken in various parts of the Empire to control soil erosion. It has been shown how the measures differ under varying conditions of soil and climate. The amount of soil erosion naturally varies in degree with different methods of cultivation and on different types of soil. Measures suitable for dealing with the problem in wet areas, where permanent crops such as tea and rubber are grown, may not be suitable even for areas of lesser rainfall where coffee is grown as a permanent crop, and more certainly will not be suitable for adoption in areas where annual crops such as cotton and cereals are cultivated. Preventive or remedial measures must be framed with due regard to the soil type, the rainfall and its distribution, and the slope of the land. They should aim at checking the velocity of the run-off and, if possible,

increasing the absorptive capacity of the soil. Soils vary in their erodibility according to their capacity for absorption, their pore space, and the nature of the clay fraction.

Certain loams have a higher absorptive capacity than sands, and it is known that soils which are inclined to swell and become sticky when they are wetted, erode much more readily than soils which "walk clean" after rains. The red loams of the wetter areas of Kenya do not erode so readily as the greyer soils of the drier areas of the Colony which have a higher silica ratio. These grey soils crack when dry and are inclined to become powdery. With the first heavy rains the top layers, which are reduced to a powdery state, are washed away readily, and when wetted these soils swell and have poor absorptive capacity. The soils of Jamaica do not erode to the same extent as those of Ceylon, and it may generally be accepted that friable soils with a low silica ratio are not subject to such a marked degree of erosion as plastic soils with a high silica ratio. The subsoil condition is also of importance and should not be overlooked in any investigations of soil erosion. In Nyasaland, for example, the formation of subsoil pans or crusts is common. Some soil types also have a special tendency to compact, and this is a factor which also should not be overlooked.

In forest soils, the maximum capacity for absorption is to be found in the upper layers, whilst in cultivated arable land this is to be found in the lower levels. This is due to the compacting action on the surface soil by the direct impact of rain. Further, a natural forest soil has been shown to have an absorptive capacity fifty times as great as the same soil when under arable cultivation. This increased absorption is due to the capacity of the surface layers, formed of forest debris, to take up water. Mulching with dry leaves and grass has been found in the West Indies to be most beneficial in cacao, lime and other fruit cultivations, and in certain areas under sugar-cane. In the cultivation of permanent crops it is therefore apparent that the first aim should be to maintain a satisfactory soil cover. This helps to protect the land from the compacting effect of the rain and to maintain the absorbent structure of the soil. A good surface litter on the soil is desirable, if it can be secured. This not only has a high absorptive capacity but it checks the beating effect of rain and prevents the silting up of the soil pore space by the washing down of finer particles. Subsidiary measures consist of terracing, contour planting, silt-pitting, contour drains, and the growing of leguminous or other plants.

In areas devoted to annual crops the establishment of contour

terraces and ridges is necessary so that they may form barriers to break the velocity of the run-off. Arable lands with annual crops suffer from erosion most seriously because they are fallow at some stage of the cultivation, and where crops can only be grown at wide intervals erosion is inclined to become worse. The amount of erosion depends greatly upon the gradient of the land, and upon whether the rainfall comes in storms or in regular showers. Anything which can be done to assist the levelling of land in a series of terraces is advantageous, and a continuous crop cover should be aimed at if possible. Local circumstances must, however, inevitably be the guide to the choice of remedies.

The soil erosion problem is still one which demands much greater attention than it is receiving even today. Areas in the upland regions of watersheds have been and are being denuded of forests, and millions of tons of valuable soil are being carried in floods to waste. Other areas of forests have been replaced by cultivations of tea, rubber, cacao and coffee, without adequate measures to safeguard against the loss of capital assets through soil erosion. The desire for early returns has led to the adoption of measures designed to force early growth by the exploitation of virgin soils, and the dangers have as yet been insufficiently recognized.

Agriculturists in many parts of the Empire have been, and are, abandoning the traditional methods of agriculture in their countries for the extended cultivation of economic crops. Such efforts are responsible for a greater waste of soil from erosion than was formerly the case, and in certain areas may lead to its ruination unless protective measures are taken.

Overstocking is becoming general in many parts of East and South Africa, and a state of devastation may soon have to be faced in certain areas.

To all Departments of Agriculture the study of the problem of soil erosion is a matter of paramount necessity, and it is to be hoped that the efforts already made, however commendable, will be redoubled in the future in the hope of finding satisfactory solutions before it is too late. It cannot be too strongly emphasized that the real solution is likely to be found in the *education of public opinion.* This will lead to a demand for measures which at present may seem to be unattainable either because of financial considerations or of apathy amongst the growers themselves. If the seriousness of the problem is once fully realized, the adoption of remedial and preventive measures will follow.

Received October, **1934.**

BRITISH COTTON INDUSTRY RESEARCH ASSOCIATION

THE SHIRLEY INSTITUTE

BY

R. H. PICKARD, D.Sc., F.R.S.

THE idea of forming a great research organization for the benefit of the cotton industry was first put forward in 1917, and a provisional committee was formed in Manchester to evolve a practical scheme. The federations and associations representing all sections of the producing end of the industry gave their support, and in July, 1919, the British Cotton Industry Research Association was incorporated. Before any work was started, the policy of the Association was defined in these words: To try to understand the chemical and physical changes produced during the manufacturing processes, and so to establish, gradually, a broad highway along which future advances may be made.

At Didsbury, just within the Manchester City boundary, the Council of the Association acquired a large mansion with some 15 acres of land, which was renamed the Shirley Institute, and formed the nucleus of the present research station. The house was altered and modernized to serve as a central administrative block, and the coach-houses and outbuildings were converted into experimental workshops. The building of the laboratories was commenced towards the end of 1920, and these were equipped and made ready for research work about a year later.

In the meantime a Director of Research (the late Dr. A. W. Crossley, F.R.S.) was appointed, and the necessary staff of research workers, which in June, 1922, numbered fifty, was recruited. A programme of research work was drawn up in consultation with sub-committees of technical men from the different branches of the industry, and covered investigations from the raw material right through all the manufacturing processes to the finished product in the form of yarn or fabric.

The research work was originally organized under departments: Chemistry (Organic and Inorganic), Physics, Botany, Colloid Chemistry and Physics. Later a Testing Department was added. This method of organization continued until some five years ago,

when the various departments were rearranged according to processes—for example, Spinning, Sizing, Weaving, Bleaching, Dyeing.

It may be of interest briefly to sketch the development and progress of the Shirley Institute from the opening of the first block of laboratories by H.R.H. the Duke of York, early in 1922, until the present time.

It was realized that the research work which the Institute had to undertake was very largely in the nature of an exploration into uncharted regions. One of the first tasks of the staff was to study the scientific literature and summarize what was known about the raw material they were to deal with. The Council decided that the Association must possess its own Library, and by gifts and purchases a start was made in building up what is now the most extensive collection under one roof of scientific and technical books and journals relating to cotton. Concurrently with their study of the literature, the research workers had to familiarize themselves with the processes of conversion of raw cotton into finished cloth, and the machinery used for the purpose. This necessitated frequent visits to mills and works, and it often happened that managers and practical men in the industry did not take too kindly to the idea that they could learn anything of value about cotton-processing from scientists with no technical experience.

The fundamental research work, which it was necessary to undertake before embarking on wider problems more closely affecting the industry, was planned and started. It was found that the establishing of the " broad highway " was a slow and laborious process, and although it was pursued steadfastly, and steady progress was made, the Institute was not without its critics, who doubted whether expenditure on research was worth while. It soon became obvious that the original laboratory accommodation was insufficient, and a new wing of six rooms, which now houses the Testing Department, was built in 1923. In the year following, all the units of the industry gave evidence of their faith in the work by doubling their contributions, and with increased staff and better facilities more rapid progress was made.

About this time the Empire Cotton Growing Corporation asked the Association to be responsible for and supervise spinning tests of Empire cottons, which were carried out under great difficulties in members' mills. From the first, active co-operation had been maintained with the Corporation. A joint standing committee of the two bodies was set up in 1922, mainly for the purpose of considering the line of demarcation between the research activities of the

Corporation and the Association. This committee was of opinion that there should not be any clear line of demarcation, but that the Shirley Institute should serve as the main centre in England for laboratory and industrial research required by the Empire Cotton Growing Corporation, and the Corporation should place at the disposal of the Association the facilities it might acquire in the cotton-growing fields of the Empire for field research. When the new laboratories were ready, arrangements were made for men appointed to post-graduate studentships under the Corporation to spend some time at the Shirley Institute with the object of being brought into touch with the problems relating to the cotton plant and fibre, and becoming acquainted with the grading of cotton, its marketing, and the processes of its manufacture. This form of co-operation was extended until a course at the Institute became a recognized part of the training of the newly appointed officers of the Corporation, whilst officers at home on leave found further visits of considerable practical value.

It will be seen that the first five years of the life of the Association were occupied largely in preliminary organization, providing the accommodation, staff and facilities for research, and laying the foundations on which applied research work could be built. During this period a large amount of fundamental work was done, and a mass of scientific data was obtained. This proved invaluable when the time arrived for the application to works practice of the results of laboratory investigations. New methods of testing were evolved, and a large number of unique testing instruments were planned and constructed. A casual examination of cotton of different growths will reveal variations in length and colour, and the experienced buyer will be able to detect other differences which are of importance. By means of suitable instruments and research methods, however, the characteristics of cotton may be stated in fairly definite terms, so that it is possible, with reasonable certainty, to group cottons, even when pulled down from the finished yarn or fabric, into the various distinctive types. As the result of the early work done by the Institute, definite information is available on the physical and chemical characters of the cotton hairs, and the industry can be given advice on the spinning quality of cottons, their tendency to form neps, and their suitability or otherwise for certain types of finished material.

It was in 1924 that the first members' visiting day was held at the Institute. Only a comparatively small number attended, and the general impression seemed to be that the display of work and

results was too scientific and too far removed from the day-to-day routine of cotton-processing to excite much interest. Probably very few of the practical men who visited the Institute on the first and subsequent members' days realized the implications and possibilities of the results of fundamental researches which were demonstrated. The regular holding of members' days was continued, and there is little doubt of the interest now displayed. At one recent demonstration extending over two days, there were 1,460 visitors from members' firms. Lectures by members of the staff provided another valuable method of contact and co-operation with the industry, and these lectures, which were, and are still, given to a large number of trade societies and organizations, have always been very much in demand.

In 1928 a new department—the Rayon Department—was inaugurated, and another wing to the laboratories was built and equipped for its accommodation. This department was the outcome of the desire of a section of the members for research to be extended to the utilization of rayon in conjunction with cotton and other fibres. The work on rayon has been carried out alongside that on cotton, and has already produced interesting and valuable results.

On the attainment of its tenth birthday, in 1929, it may reasonably be claimed that the Association had established the " broad highway " which was originally laid down as its policy, and possessed the knowledge, the staff, and the facilities necessary to make future advances for the benefit of the industry. The researches which had been undertaken at that time covered a very wide field, and included properties of the cotton hair and its variations under specified conditions of growing and breeding, strength and other qualities of yarn, cloth structure, sizing, bleaching, mercerizing, dyeing and finishing, as well as investigation of the machinery used in the various processes. The large fund of knowledge which had been acquired, though no doubt far from complete, was sufficient to enable every link in the chain of manufacture to be critically examined. Methods of process-control had been created and utilized by the industry. Improvements and refinements in processes and machinery had been made and developed. The causes of imperfections of obscure origin had been ascertained, and recurrences prevented. Many day-to-day problems and difficulties of the industry had been solved and overcome.

In 1929 the Council decided that the time had arrived to extend the operations of the Association. They recognized that laboratory results could not be of value unless and until they were applied in mills and works, and effective methods were initiated to provide

a bridge, by means of which research results could be got over to the trade. An important decision was made to provide extensive experimental workrooms in which laboratory results could be tried out, instead of, as hitherto, in members' mills. These buildings were erected in 1930, and, with the generous assistance of textile machinists, were equipped with the most up-to-date machinery for spinning, sizing, and weaving. One of the reasons for the provision of the experimental spinning room was to enable spinning tests for the Corporation to be carried out at the Institute under controlled and reproducible conditions of temperature and humidity, and under the direct supervision of the staff. This was obviously impossible in the mills. A separate section of the Spinning Department was formed to deal exclusively with these tests, and it is believed that the reports of the Institute on samples of new growths of cotton sent in by the Corporation's officers have been of vital importance, and have avoided much waste of time and effort.

Owing to the trade depression and the financial stringency of the last few years, the projected development and expansion of the work of the Shirley Institute had to be slowed down. During the same period the demands by members for "service" had increased remarkably, and the staff was flooded out with enquiries, special investigations, and examinations of faults and imperfections. The increase in the number of these enquiries and examinations during the last few years will be seen from the following figures:

Year Ending September 30.	*No. of Enquiries and Examinations.*
1929	500
1930	850
1931	1,400
1932	1,550
1933	1,750
1934	2,000

These figures alone will show that the industry has "accepted" the research association. There may be a few still unconvinced of the practical value of scientific research, but the number is steadily diminishing.

In addition to the special examinations, a large number of statistical and other investigations by the Shirley Institute have been undertaken in mills. This growth in "application" work has taxed the capacity of the staff, and has necessarily resulted in the curtailment of the fundamental research work in progress and the neglect of new fields of fundamental research. In his speech to members at the Annual General Meeting of the Association held in

November, 1934, the Chairman of the Association stated that the Council had come to the conclusion that it was unwise, if not dangerous, to allow this state of affairs to continue. They had decided that there must be no cutting down of the service to members, which they regarded as essential to the industry today, and no neglect of any fundamental research, which they believed would be equally essential to the industry tomorrow. They had appealed for increased funds, and were arranging for more accommodation, staff, and equipment, so that the delayed development of the Shirley Institute might be proceeded with.

The response to the appeal has been most encouraging, and the fact that, in a time of long-continued depression, members are prepared to increase their contributions for research is adequate proof of the usefulness of the Institute.

As a recognition of the value and importance which they attach to the work on spinning tests, the Corporation have made a generous increase in their subscription to the funds of the Association, and their action is very highly appreciated.

The work of the Institute has already, in a number of directions, eliminated those "rule-of-thumb" methods by which the industry was carried on for many years, and has substituted methods of scientific control. It has resulted in improvements and economies in processes, gradual refinements all along the chain of production, and a finished article of higher quality. By means of intensive investigation of the processes of the industry, it aims at raising its general technical efficiency.

The contact between the technical experts in the industry and the scientific workers in the laboratory has become closer and more continuous; all are working for one common object.

A large number of Shirley Institute reports are released for open publication in the *Journal of the Textile Institute.* These are known as "Shirley Institute Memoirs," and are issued in bound form by the Association. The first volume was published in 1922, and twelve volumes are now available; the thirteenth will be ready shortly. In addition to these, confidential memoirs are supplied to members only, and the *Shirley Institute Confidential Bulletin* is issued to members every six weeks. The Institute also publishes a *Summary of Current Literature* containing abstracts of papers and articles relating to cotton and rayon which are contained in British and foreign scientific and technical journals.

The details of the new extensions have not yet been definitely settled. The present intention is that they shall consist of a labora-

tory block of some twenty-four rooms, and considerable additions to the experimental spinning and weaving rooms. With the proposed additional buildings, the Shirley Institute, laboratories, and experimental workrooms will cover about 2 acres of ground, and will provide upwards of 100,000 feet floor-space. The total capital cost of buildings, equipment, and machinery will exceed £180,000. The present staff of the Association is well over 200, more than one-third of the total being University graduates.

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COTTON CULTIVATION IN CYPRUS

BY

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In Cyprus there is a wide range of soil and climatic conditions allowing for many diverse agricultural activities, amongst which the production of cotton holds a position worthy of attention. Cotton, like many of the other crops now grown in the Island, was produced in ancient times, and periods of prosperity as well as adversity are recorded, yet the crop has maintained a position of importance as a product of the Island through the ages up to the present time. Besides its economic value to the Island as an export crop, a fair percentage of the production is utilized annually in the local village industry of spinning and in the weaving of cotton fabrics.

Before describing the cotton crop in detail, some brief notes on the Island, followed by a general outline of the agricultural resources and conditions, are given to enable the reader more fully to appreciate the position of the cotton crop in relation to the other crops and agricultural industries forming the rural make-up of Cyprus, as well as to give an indication of the various factors limiting or assisting production.

Cyprus is subject to intense heat in the plains during summer and cold during winter. October to March are the rainy months, and from May to September practically no rains fall. The outstanding topographical features are the two distinct mountain ranges, namely the Southern and the Northern ranges, and the Messaoria plain. The highest point of the Southern range is 6,406 feet, and the mountains of this range are extensive and form the water catchment area upon which the Island mainly depends. The Northern range extends some 100 miles along the coast through Kyrenia District and the Karpass; the highest point is 3,433 feet. The Messaoria plain is an extensive stretch of agricultural land lying between the two ranges and extending from the Morphou Bay area to Famagusta. (See Fig. 1, Map of Cyprus.) The area of the Island is 3,584 square miles.*

The population of the Island numbers 347,959 persons, of whom 64,860 are resident within the municipal limits of the six principal

* "Handbook of Cyprus," Storrs and O'Brien.

district towns. The majority of the people living in the villages and rural areas throughout the Island are engaged in agricultural pursuits. The total area of cultivated land is estimated at 2,331,436 donums,* of which there are 2,100,586 donums of arable land, the remainder being vineyards and gardens. The above figures represent the land at present farmed by the peasantry in small holdings, but the areas given are believed to be under-estimated. Large scale farming is not practised, and with the exception of a few " chiftlicks " or estates, monastery and church lands, the agricultural resources of the country are developed by the peasant small holders.†

Owing to the mountains there are different rainfall zones (see Fig. 2, Cyprus Rainfall Map), and in the plains, where the dry period is prolonged, it is necessary to irrigate many crops in order to increase production sufficient for the needs and welfare of the population. With such diverse conditions obtaining in the confines of a comparatively small Island varied agricultural pursuits are necessary, and therefore the possibility of Cyprus becoming dependent on one or two crops only is unlikely.

The important agricultural products which contribute to the agricultural wealth of the Island are cereals, carobs, olives, vine products, potatoes, cotton, tobacco, linseed, citrus fruits, deciduous fruits, animals and animal products, almonds, silk, and vegetables. Annual crops grown on arable land are grouped as Spring, Summer and Winter crops, and different rotations are practised so far as conditions permit and if the land can be irrigated. The area and production of summer crops varies from year to year, according to either marketing conditions, seasonal rainfall, or quantities of available irrigation water.

Assuming marketing conditions are favourable, the question of an increased supply of irrigation water is of vital importance. The Cypriot peasant, however, is handicapped in many ways, owing to general conditions of land tenure, indebtedness and usury, in making use of any large scale irrigation water supplies even if such were available. Nevertheless, until more prosperous times for the peasant materialize, there is no lack of enterprise in making use of whatever water it is possible to raise by hand, animal, wind or motor power from wells on private lands, by irrigation from the limited number of perennial springs, or from chains of wells. The chain of wells system is arranged by sinking a number of wells at regular intervals apart; these are linked up by underground tunnels, and the water brought to the surface through a channel at a convenient place

* 1 donum = ⅓ of an acre. † Report on the Census of Cyprus, 1931.

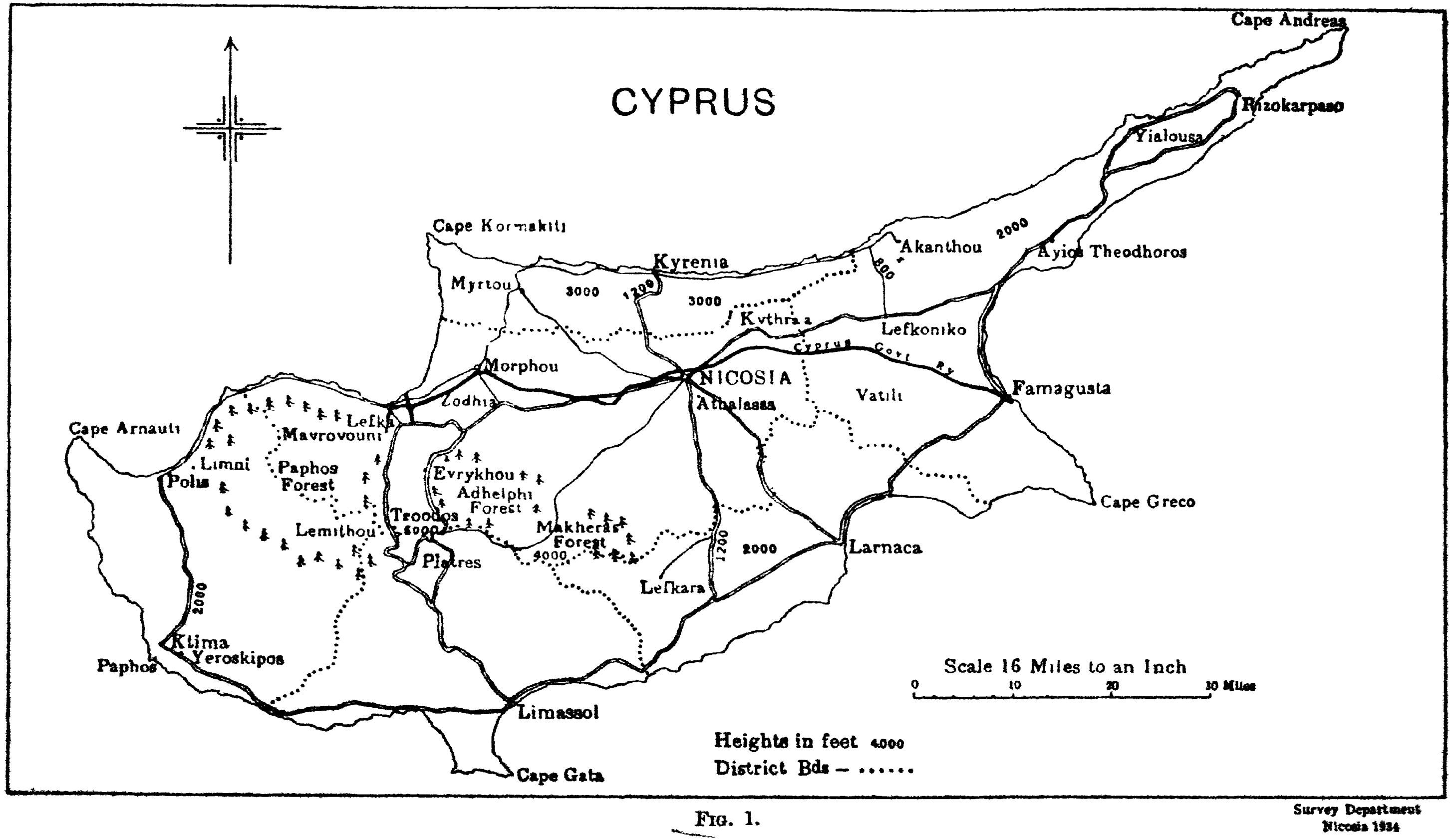
CYPRUS
Cape Andreas
Rizokarpaso
Yialousa
Ayios Theodhoros
Akanthou
2000
800
Cape Kormakiti
Kyrenia
Myrtou
3000
1200
3000
Kythraa
Lefkoniko
Cyprus Govt Ry
Morphou
NICOSIA
Athalassa
Famagusta
Vatili
Zodhia
Lefka
Cape Arnauti
Mavrovouni
Limni
Paphos Forest
Polis
Evrykhou
Adhelphi Forest
Troodos
6000
Makheras Forest
Cape Greco
Lemithou
Platres
4000
1200
2000
Larnaca
Lefkara
2000
Ktima
Yeroskipos
Paphos
Scale 16 Miles to an Inch
0
10
20
30 Miles
Limassol
Heights in feet 4000
District Bds — ......
Cape Gata
Survey Department
Nicosia 1934

FIG. 1.

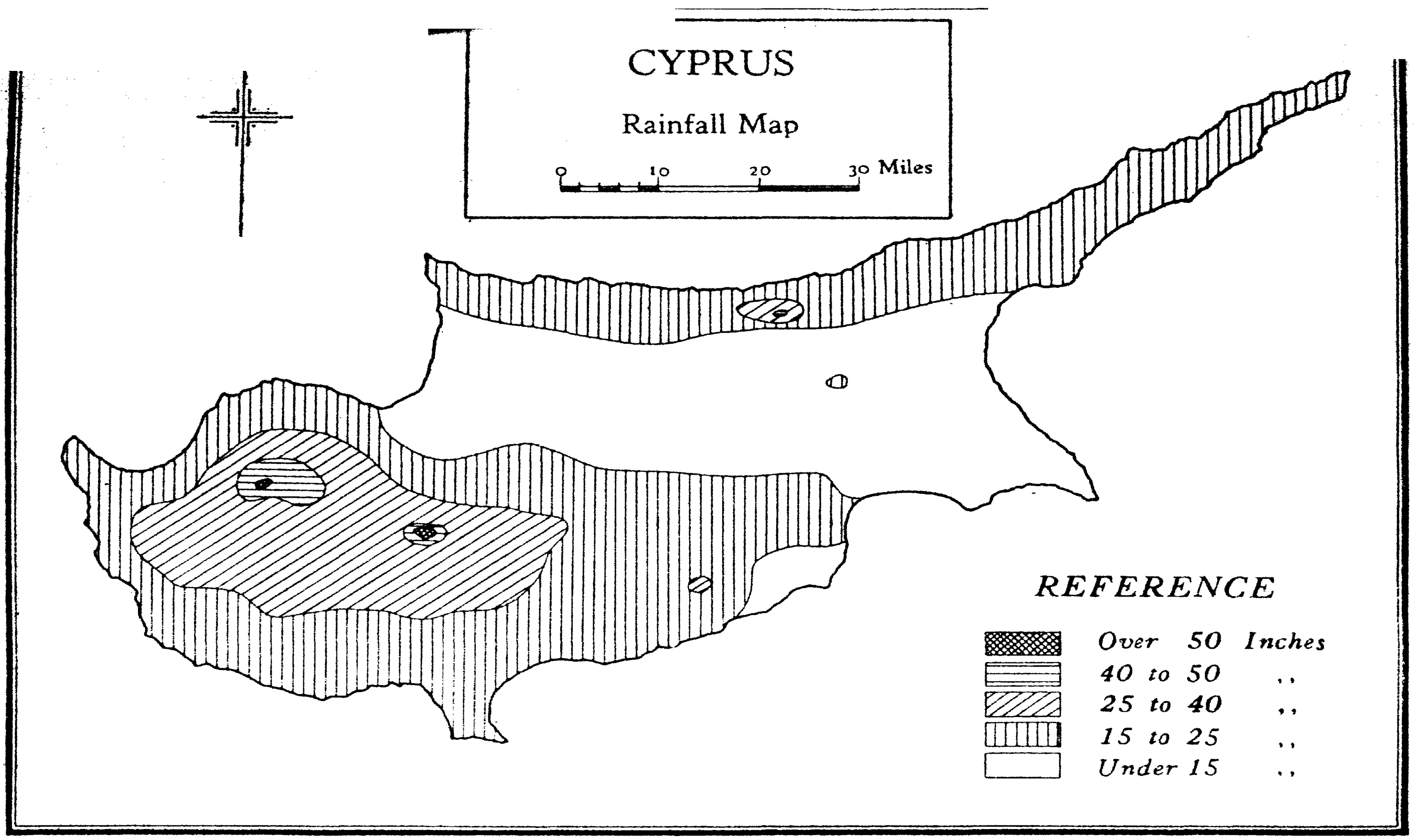
CYPRUS
Rainfall Map
0 10 20 30 Miles
REFERENCE
Over 50 Inches
40 to 50 ,,
25 to 40 ,,
15 to 25 ,,
Under 15 ,,

FIG. 2.

according to the slope of the land. Use is also made of river flood waters in winter by diverting through flood channels the silt-laden water over the cultivable land.

The soil and climatic conditions are favourable for the production of cotton, and many references can be traced indicating the importance of this crop during the various periods in the history of Cyprus. During the Venetian occupation Cyprus hand-woven cotton cloth was in demand in the Levant, and the cotton industry of the Island was believed to have assumed its greatest importance during the seventeenth and eighteenth centuries. The industry declined somewhat during the Turkish rule on account of taxation of the crop, but made some recovery after the British occupation in 1878, when this form of taxation was abolished. Since the British occupation there have been no indications at any period of a marked increase in production, nor any signs that the crop was dwindling out of existence. Apart from seasonal variations in area planted and quantities produced, due to drought or other such conditions, the crop, from the point of view of its place of importance to the Island, has practically remained stationary.

Cotton in Cyprus is cultivated as a summer crop and is grown on irrigated and non-irrigated lands. Planting takes place during the months of April and May and early June, according to locality, season, and whether the crop will be irrigated. Picking commences in September and continues until the end of November. The selection of land for the production of non-irrigated cotton depends upon the moisture retained by the soil after the winter rains or flood waters. The non-irrigated crop is usually planted on the flat and irrigated cotton on ridges, irrigations being given at regular intervals throughout the growing period. Long-stapled varieties are grown under irrigation and the production of non-irrigated lands is short in staple.

The annual average rainfall for the whole Island during a period of forty years from 1894 to 1933 was 19·19 inches. A glance at the rainfall map (Fig. 2) shows the rainfall zones of a normal average year. The cotton-growing areas are practically all situated in the zone of 15 inches or under.

The table on page 21 shows the average rainfall each month for a period of nine years at Nicosia, Morphou and Akhyritou. This gives an indication of the distribution of the seasons' rainfall of the cotton-growing centres in the plains.

The quantity and distribution of the winter rainfall is the determining factor in deciding the total area to be planted to cotton. On this account there is an annual variation in the proportion of irrigated

to non-irrigated crop. In seasons of heavy winter rainfall when the rivers flood sufficiently to allow for flood water to be distributed over the fields destined for cotton cultivation without irrigation, many of the irrigable fields are used for other crops. If late spring rains follow, the cotton crop is assured and yields are good.

AVERAGE RAINFALL FOR A PERIOD OF NINE YEARS, 1925–1933

Month.	*Nicosia.* (*Inches.*)	*Morphou.* (*Inches.*)	*Akhyritou.* (*Inches.*)
January	3·62	2·67	3·41
February	2·81	2·56	2·47
March	0·89	0·87	1·35
April	0·50	0·60	0·63
May	0·65	0·31	0·63
June	0·23	0·003	0·10
July	0·08	—	0·02
August	0·11	0·08	—
September	0·38	0·20	0·17
October	0·59	0·26	0·69
November	1·09	1·02	1·35
December	2·16	2·06	2·63
Total	13·11	10·633	13·45

In a paper on "Investigations of Soil Profiles from Cyprus,"* published in *The Empire Journal of Experimental Agriculture*, the following classification of Cyprus soils was given:

Red serpentine loams.
Red and yellowish-brown loams on igneous rocks.
Mediterranean steppe soils on igneous rocks.
Greyish-brown Mediterranean steppe soils on limestone, marl and sandstone.
Terra rossa.

The first three of the above groups are mainly found in the mountains and northern foothills of the Southern range. Cotton is grown on the soils of the two latter groups—namely, the greyish-brown soils which are mainly found in the central Messaoria, Karpass, and the greater parts of Larnaca, Limassol and Paphos districts along the coast and southern foothills of the Southern range, and the terra rossa, or red soils, which are found in the Morphou Bay area and parts of Famagusta and Kyrenia Districts.

The average area planted in recent years is some 10,000 acres

* "Investigations of Soil Profiles from Cyprus," A. Reifenberg and Elinor K. Ewbank, *The Empire Journal of Experimental Agriculture*, April, 1933, Vol. I., No. 1.

per annum, but there is often a considerable fluctuation in yield from year to year. This is mainly accounted for by the variation in the proportion of irrigated to non-irrigated land planted.

The records of production since the British occupation show that this has been steadily maintained, and the following figures give the average yearly production for five decades.

Decade Ending—	*Average Yearly Production of Seed Cotton.*
1889	2,331,392 lbs.
1899	3,140,928 ,,
1909	1,095,920 ,,
1919	2,895,200 ,,
1929	3,569,888 ,,

During the last four years the average annual production amounted to 1,290,128 lbs. seed cotton. The Island is now recovering from the effects of three years' drought, which accounts for the low production during the last four years. In the decade ending 1909 a drought almost as severe as that of 1931-33 took place in the years 1901-02.

The areas where irrigated cotton is generally grown are the Morphou Bay area, Solea Valley and other parts of Nicosia District, especially in the neighbourhood of Kythrea, Nissou, Dali, Potamia, and Tymbou; the Messaoria villages of Famagusta District and the Karpass; Kiti, Perivolia and Livadhia in Larnaca District; Episkopi and Kolossi in Limassol District; Ktima, Ashelia, Kouklia and Polis in Paphos District; and Lapithos and Karavas in Kyrenia District. Non-irrigated cotton is grown in most villages in the plains and around the coast.

The native varieties cultivated in the early days were derived from the species *Gossypium herbaceum*, and a strain of this species is still produced in the Island for use in the local spinning and weaving industry. Small varieties of a brown cotton are also grown in limited quantities, the brown lint of which is used to make cloth of the natural colour of the lint. At different periods since the British occupation a number of American varieties have been introduced, but none of these have been kept pure, and the bulk of the cotton now produced in the Island is a strain not commercially pure and locally known as Titsiros. Several Egyptian strains have also been imported for trial, and some success has resulted from an imported variety, Mesowhite, obtained from Iraq.

Sufficient attention is not given by the planters to spacing, thinning and weeding, picking is badly done, and grading is not practised. Ginning is carried out by local merchants who own one or two gins

only, and the ginning is done unsystematically over a long period during the winter months.

The most serious insect pest is the Pink Boll Worm (*Platyedra gossypiella*). Other pests causing damage to a lesser extent are the Spiny Boll Worm (*Earias insulana*), the Small Black Stainer (*Oxycarenus hyalinipennis*), Aphids (*Aphis gossypii*), and various species of grasshoppers which attack young plants.

There is no legislation controlling the industry as regards seed distribution, marketing, or ginning, but under the Diseases of Plants Prevention Law measures are provided for:

(*a*) regulating the import of cotton seed; and

(*b*) uprooting and destroying or ratooning all cotton plants annually by a fixed date.

The average quantity and value of the exports of cotton lint and cotton seed for the last two five-year periods were:

Period.	*Cotton Lint.*		*Cotton Seed.*	
	Quantity in Bales of 400 Lbs.	*Value.* (£)	*Quantity.* (*Cwts.*)	*Value.* (£)
1924–28	2,998	42,759	6,729	2,299
1929–33	3,086	28,374	8,023	1,855

Greece absorbs most of the exports, but a certain amount is also sent to the United Kingdom. The Greek importers purchase ungraded cotton from Cyprus and freight charges are low from the Island to Greece.

The average quantities exported to the United Kingdom during the two five-year periods given in the preceding statement were:

Period.	*Bales of 400 Lbs.*	*Value.* (£)
1924–28	838	12,337
1929–33	540	6,904

While the cotton crop is readily marketed either by occasional consignments to the United Kingdom, by the demand for short-stapled lint from the Continent of Europe or by the use of low quality cotton in the village hand-spinning and weaving industry, there has

been little incentive for the grower to improve upon his methods of production, for the merchant to alter his methods of handling the crop, or for legislation to assist either, especially when the crop is liable to the effects of drought and the irrigable lands are limited.

Recently, however, very active interest has been taken in the development of irrigation water supplies by Government and by private enterprise, and new areas of irrigable lands are becoming available. Most of these areas are being developed for citrus planting; nevertheless, arable farming has a very definite place in Cyprus agriculture, and as greater areas become available for the production of crops under irrigation, it will be necessary to increase the area of such crops as are remunerative to grow. The history and present position of the cotton industry fully demonstrate the possibilities of cotton production, especially if the quality of cotton required by the United Kingdom market can be produced. With a view to supplying this market, and regaining the former position of importance the cotton industry held in the Island during the Venetian occupation, experiments are to be carried out at the Central Experiment Farm, Morphou, with the varieties considered most suitable to grow under Cyprus conditions.

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SOME FACTORS AFFECTING THE GEZIRA IRRIGATION SCHEME

BY

R. HEWISON

THE possibility of irrigating the Gezira plain was first considered over thirty years ago. It is twenty-three years since the first experimental cotton plantation was established and ten since the dam and canalization system came into operation. It may be interesting, and possibly useful to those responsible for the development of similar projects elsewhere, to recall at this stage some of the considerations upon which the Scheme was originally based, drawing attention to the special features on which its success depends, and to those factors which restrict within definite and somewhat narrow limits the system of agriculture it is possible to pursue in the irrigated area. Within the limits of a single article it is not possible to do justice to these aspects of the Scheme, and at the same time to discuss in any detail the results which have been obtained. It is hoped, however, that in a later article some history of these results may be linked up with the discussion of basic factors attempted here. The importance of some of the factors which will be referred to was apparent from the commencement; the significance of others, however, has only been realized as experience in connection with the practical working of the Scheme has accumulated. In order to make the position clearer, particularly as regards one of the main factors—*i.e.*, the water supply—it is necessary to make some reference to the history of the initial stages of the project.

Originally the assumption had been that development by means of irrigation in the Gezira would follow closely on Egyptian lines, not only as regards irrigation works, but also in respect of agricultural practice. In connection with cotton-growing this would have entailed a considerable water supply for the Gezira during the months in which the discharge of the Nile is at its lowest. At that time and under the then existing relations of Egypt and the Sudan, such a proposition might have been, and in fact was considered. The experience of the 1913-14 flood, however, effectively opened the eyes of the responsible authorities to the limitations of the supply which

the Nile could provide without further storage works. It is quite certain that after this experience there would have been no question of proceeding with an irrigation scheme for the Gezira, which entailed withdrawing water from the river during the months of low supply until, at any rate, such time as conservation works on the White and Blue Niles had made the position of Egypt secure, and had provided a surplus for use in the Sudan. It is fortunate, therefore, that before this stage was reached the original conception of the Scheme, on definitely Egyptian lines, had been abandoned.

As a result of the various experiments carried out and the practical efforts in cotton-growing made at different points, it had become evident that the time of the year during which cotton could be successfully grown in the Sudan was not necessarily the same as that during which it was only possible to grow the crop in Egypt, and, in fact, that the best results could only be obtained by adopting an entirely different season.

Results at the experimental station at Khartum and elsewhere had shown that in that region the most favourable months for cotton-sowing were probably July and August, as against February to April in Egypt. It was the realization of the significance of this evidence of the difference in the natural conditions which first reduced the Gezira Scheme to a question of immediate practical politics. The fact was known that from some date in July until about the end of December the Blue Nile carried much more water than Egypt had used or could ever utilize during that period of the year. It became a question then as to whether an irrigation scheme for the Gezira, having a reasonable prospect of financial success, could be put into operation on the basis of using this water, admittedly surplus to Egypt's requirements.

Even on the pre-war estimates of the cost of the necessary works it was obvious that such a project could only be justified if it could be shown that the agricultural conditions were such as would ensure the production of some crop for which a wide and continuous demand existed, and which would command a price sufficient to allow it to bear the cost of transport to the sea-board, and thence to the centres of demand. Everything pointed to Egyptian cotton as the crop which, under the conditions, was most likely to meet these requirements. It was therefore decided to undertake an experiment in the growing of Egyptian cotton in the Gezira on a commercial scale and under the conditions, as regards irrigation, imposed by Egypt's established rights in the natural flow of the Nile.

This decision was put into practical effect by the establishment

of the Tayiba station in 1911. The experiment was a success and gave clear proof that Egyptian cotton, giving a high yield of good quality, could be grown in the Gezira under these conditions. On these results it was decided to go ahead with the Scheme, and a project was prepared which in main essentials is that now in operation. Work was actually started, but the war prevented the immediate carrying out of the full project.

The economic basis of the Scheme when undertaken, therefore, was the production of high-grade Egyptian cotton under the conditions of water supply described above, and as far as can be seen its financial success still depends, and is likely to do so, upon the value of the cotton crops that can be produced under the conditions and restrictions, natural and otherwise, which are found to exist.

The possibilities of any agricultural proposition are limited by the effects of certain factors, of which the most important are: Water supply, whether from rainfall or irrigation; soil; climate; cultivating population; insect pests and plant diseases; markets and transport facilities.

In the case of the Gezira the factor which comes first into operation in limiting and defining the agricultural system is the water supply. Not only is the total quantity of water available for irrigation definitely limited, but the periods of the year during which it can be utilized are also the subject of definite restrictions in Egypt's interests. In effect this has meant that, while there is a considerable supply available from about July 20 to the end of the year, any irrigation required between January 1 and July 20 must be provided for out of the volume stored behind the Sennar Dam. As the amount which can be stored is limited by the capacity of the reservoir, it follows that the bulk of the irrigation must be carried out during a restricted period, and that only such crops can be grown as will succeed at this season of the year, and under the conditions as regards water supply which the restrictions involve.

The practical effect of this upon the system of farming is to limit very narrowly the range of crops that can be cultivated. Further, to take advantage of the water while it is available, all the crops it has been found possible to include in the rotation must be sown at about the same time, and all compete for labour in connection with planting and weeding during the early weeks of the season. The early weeding and first waterings of the cotton crop are important matters, and have an undoubted effect upon the ultimate yield, and it would be possible to insist upon these operations being more carefully and effectively carried out if supervising staff and cultivators alike

were not pressed by the necessity of irrigating and cleaning the full area under cotton, dura, and lubia at the same time.

Soil.—A factor of great importance in connection with the Scheme is the nature of the soil. Very little was known about the Gezira soils when the Scheme was under consideration, beyond the fact that in years of good rainfall they were capable of producing fine crops of dura under native methods of cultivation. A somewhat sketchy soil survey was carried out, a series of samples being taken at rather wide intervals over the area. Chemical and mechanical analyses of these samples appeared to show a striking uniformity, while revealing an apparently very gradual change in the nature of the soils from South to North.

These examinations supported opinions based on surface observations of what appeared to be a very uniform plain, but failed to reveal the local variations in the quality of the soil, which have since been shown up in the crops produced under irrigation. These variations in soil fertility occur more frequently, and are more sharply defined than would be expected from surface appearances; even now, after twenty years of practical experience, and over ten years of intensive chemical and physical research, their nature and origin are only partially explained.

While the soil of the Gezira has shown itself capable of producing good yields of high-quality cotton under favourable conditions, it has certain qualities and defects which cannot be ignored, and which impose definite limits upon the system of cropping that can be followed. It is a heavy soil, with a high clay content, a high degree of alkalinity and a considerable salt content. It is generally somewhat impermeable, in certain cases the degree of impermeability being very high indeed.

Examination of the natural flora of the Gezira plain shows that only a very limited number of species are capable of thriving on this type of soil. This limitation has been found to apply to the agricultural crops it is possible to grow successfully. Experiments with many of these have been carried out, but beyond those at present included in the rotation—viz., cotton, dura, lubia and to a limited extent the pigeon pea—very few have shown any promise at all. Lucerne, wheat and barley can be grown, but for economic reasons, and on account of their water requirements, they are not a practical proposition under existing conditions.

The particular qualities of the Gezira soil have necessitated the inclusion of a considerable fallow period in the rotation of cropping adopted. Under constant irrigation, land of this type is inclined to

become very compact and to lose such permeability as it originally possessed. It is necessary, therefore, to allow the land to lie fallow and unirrigated for considerable periods, in order that the natural drying out, cracking, and opening up of the soil which occur under the influence of the prevailing climatic conditions, may restore its physical condition and permit of the reasonable penetration of water, air, and the roots of plants.

In view, moreover, of the effects produced in other parts of the world by the injudicious irrigation of land containing an appreciable amount of soluble salts, it is certainly expedient to restrict the periods of intensive irrigation to as small a proportion of the whole rotation as is economically possible until, at any rate, chemical research and other studies have added a great deal to the present knowledge of the effects of these salts and their reactions with the soil, water, and crops. In practice, then, the combined limitations imposed by the conditions affecting the water supply and the nature of the soil restrict within a very narrow range the crops which, as far as present experience goes, can be successfully grown in the Gezira.

Climate.—The meteorological factors exerting the greatest influences on the agriculture of the Scheme are temperature, humidity, and rainfall. As regards effects upon crops and the soil the year may be divided into two seasons. From about the middle of October until the end of May or middle of June the climate is definitely arid. High temperatures and low humidity are the main features, though during December, January, and February the temperature may drop considerably for periods of varying duration.

Normally the rainy season commences with light showers in June. Falls become heavier and more frequent in the second half of July and throughout August, diminish in frequency and intensity during September, and cease altogether in October. The bulk of the rainfall occurs as a rule during a period of six or seven weeks commencing in the third week of July. July, August, and September are normally months of high humidity and lower maximum temperature, the change to arid conditions occurring, somewhat abruptly as a rule, in October. Conditions such as these are not in themselves unfavourable to the growth of the cotton crop.

The prolonged spell of arid conditions in each year, moreover, has profound effects upon the physical conditions of the Gezira soil. In fact, but for these effects, it is doubtful whether it would be possible to maintain under arable cultivation a soil with such a high clay content.

Under the conditions of high temperature and low humidity the

soil is quickly dried out after the rains or irrigation, the rapid loss of moisture causing a marked shrinkage evidenced by the widespread cracking which occurs. The depth to which cracking extends varies considerably with the nature of the soil and subsoil, but under favourable conditions it may be to as much as five or six feet below the surface in a single season. Connecting with the main fissures a system of finer cracks extends throughout the whole mass of the soil affected. The alternate shrinkage and expansion continually in progress along the lines of these cracks affects every particle of the soil, and produces a tillage effect which no mechanical process could achieve, with the result that even on this very stiff soil an excellent tilth can be obtained with the minimum of cultivation.

The rainfall probably affects the cotton crop more than any other meteorological factor. There is an undoubted connection between the rainfall at certain periods and the incidence of one of the most important plant diseases in the Gezira—*i.e.*, blackarm. Early rains—*i.e.*, rains occurring a month or two months before the cotton is planted—appear to have a considerable and adverse effect upon the crop. This effect is apparently produced through some change, or changes, in the soil induced by such early rains. The nature of these changes has been the subject of considerable study, but so far has not been satisfactorily explained.

The *cultivating population* is a factor of great importance in connection with the continued success of the Scheme. Practically the whole of the land included was held in private ownership by natives of the district. Naturally these landowners were regarded as having a priority of claim to cultivating tenancies of the irrigated land. Considering their previous agricultural history and experiences, it must be conceded that up to a point they have done fairly well as farmers of irrigated land. It must be admitted, however, that they could do much better and that signs of real improvement are disappointingly lacking. Constant supervision of the tenants is required in order to obtain from them the full efforts necessary at times of pressure, or anything like the unremitting care and attention that such a crop as irrigated cotton requires. In fact, effort is very generally restricted to the minimum necessary to enable them to retain a holding.

With a completely free hand, selection of the better cultivators might be made that would raise the general level very considerably. It is not intended to suggest that such a selection at the expense of the registered rightowners should be undertaken, but rather to point out that the Scheme, as it exists, is not one in connection with which it is possible to insist upon the maximum efficiency, or to expect the

results which could be obtained under similar conditions, by a population possessing the agricultural qualities of, say, Egyptian Fellahin.

Insect Pests and Plant Diseases.—The effects of the various pests and diseases vary from year to year, and in certain cases there appears to be a definite connection between seasonal variations in climatic conditions and the extent of the damage caused by them. While it is difficult to estimate with any accuracy the amount of loss sustained in any one season or to allot to any one or other of the agencies responsible a correct proportion of the damage caused, it is quite definite that a considerable loss occurs in every year, and that in some seasons the reduction in yield is a really serious matter.

Market and Transport Facilities.—Generally, and considering its geographical position, the Gezira area is not unfavourably situated in regard to these. Transport conditions, in regard to internal communications, port facilities, and shipping, are good, the one great disadvantage being the long distance that separates the Gezira from the markets to which its produce must be sent. Even with the facilities obtaining, the distances over which produce must be carried entail high transport costs. Such costs can be borne by high-grade produce only, and it is fortunate that the cotton it is possible to grow in the Gezira is of this class. The maintenance of a high standard, and of the uniformity of quality which is nearly as important, is therefore a matter of the greatest importance.

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DRAINAGE IN THE SUDAN GEZIRA

BY

W. LAWRENCE BALLS, Sc.D., C.B.E., F.R.S.

Art is long and time is fleeting. The fifty-second meeting of the Council of the Empire Cotton Growing Corporation reports that "the principal factor which had depressed the yield of cotton in the Gezira in so many seasons, even in years when damage from disease was not serious . . . appeared to be connected with lack of aeration of the soil, and the effect of that condition on the plant's root development." Twenty-one years have had to take flight in order to obtain recognition for what was obvious to Mr. E. R. Sawer in 1913. It is a pleasing tribute to his pioneer work, but apart from that it merely shows how fixed ideas can waste the time of a whole generation, and lose millions of money.

It is easy to claim wisdom after the event, so I propose to justify the claim by some quotations from both published and unpublished accounts of a visit which I paid to Khartoum and Tayiba in January, 1914, when the pump-scheme at the latter place was in its third year of demonstration, and the complete Gezira scheme was being settled. In these accounts I point out that I was merely collating and co-ordinating the various local opinions, weighing their various values according to my personal judgment based on my ten years in pre-war Egypt which had then just ended. I dealt with politics, the plant, the climate, diseases and pests, labour, public health, rival crops, and—at greatest length—with the soil. The unpublished account which I prepared for the late Mr. J. W. McConnel has since been in the hands of several people intimately concerned with the Gezira problem, but I will begin by quoting the three articles which appeared in *The Near East* of 24th April, 1st May, and 8th May, 1914, under the title "The Sudan and Cotton":

> "The appearance of the unimproved soil is deceptive, the silt particles being aggregated into clumps which are broken down by heavy waterings, such as irrigation would provide, thereby puddling the soil. A soil of this nature cannot be cultivated without free drainage. . . ."

Of course, the soil *was* being cultivated, and there was the five-kantar crop as a hard-edged green rectangle in the middle of yellow semi-

desert, so the statement could have no practical sense in it. However—

> " . . . cannot be cultivated without free drainage, but at present the natural drainage is sufficient in many places, because the natural water-table is over fifty feet below the surface. In certain spots, however, the land lies wet after irrigation, indicating that the natural underdrainage is hampered by impermeable beds. Since the roots of cotton probably descend quite ten feet below the surface in the Sudan conditions of soil-temperature . . ."

Provided that the soil is penetrable, and aerated, of course understood.

> " . . . a much deeper layer than four feet (the depth of the Chemical Survey samplings) has to be taken into consideration, and it is more than likely that such trapping of drainage may take place erratically over large areas. Further, the experience of the Punjab and Wyoming shows that even a very deep natural water-table may be raised to the surface, quite apart from the superficial water-logging of clay patches."

This was amplified somewhat in the unpublished account, where there is a hint of anticipation of modern views on soil genetics.

> " The secondary formation of a hard impermeable layer in a plane parallel with the soil surface is termed 'panning.' Such pans of cemented particles arise in many ways, the cementation being effected by pressure of the plough-sole, by iron salts, by lime, etc. A very hard subsoil has been formed at Zeidab which is believed to be impenetrable by the roots of the cotton plant, thereby keeping the root-system cramped and superficial. . . . The change from shadoof irrigation, with limited water-supply, to the ample water-supply from pumps, brings about curious movements of pans. . . . The absurdity is then reached of a light soil which is water-logged by a light irrigation, and completely desiccated in a few days after, because the surface-applied water cannot sink downwards, nor can the ground-water rise upwards. . . . The main risk of water-logging lies in the formation of a 'floating' water-table in the impermeable patches."

To return to the verifiable published account, written in popular form for the readers of *The Near East*.

> " Combining these facts with the effects of the two-metre drains at Khartoum North Farm, it seems clear that drainage provision is highly necessary for the permanent success of the Gezira project, and that only a few years without it might suffice to do serious injury to the credit of the district."

The forecast was ineffective to fulfil its purpose (the installation of provision for drainage), but the " serious injury to credit " has

happened strictly according to plan. After reference to three variations of climate which could each knock 10 per cent. off the crop, and the probability of future accretions of insect pests, we conclude the three articles thus:

> "All things considered, it does not seem justifiable to assume that the Gezira can possibly give so high a yield of cotton per acre as Egypt can, and about 350 lbs. per acre seems a reasonable average for a series of years, or three and a half million kantars, of which two and a quarter will be Egyptian from the south-western portion."

And so far as this opinion was considered at all, it was considered to be the fantastic pessimism of a disgruntled theorist, not worthy of practical respect!

Much more could be quoted, but it might well be asked why no attempt was made to turn these theories into action. The minutes of the Cotton Growing Committee of the Board of Trade, parent of the Corporation, provide an answer, dated 1st August, 1917.

> "*Question:* In the memorandum which we have before us irrigation is spoken of as 'irrigation.' Does that include drainage?
>
> "*Answer:* No. The reason is, as I have tried to explain, that this is a high plateau. . . . It is quite possible that a long number of years of intensive cultivation with constant watering may bring into prominence the necessity for a drainage scheme. All the major canalization system is so arranged that, if it is ever desired, a drainage scheme can easily be put down . . . all that will be necessary will be to dig relatively very small canals. . . . I do not believe for a moment you could ever get five cubic metres to flow down. . . . X. Pasha agreed with me that it would be some years before drainage would become a prominent thing in the Sudan.
>
> "*Question:* You have answered the point that I wanted to put: That provision has been made for a drainage system in the original scheme?
>
> "*Answer:* Quite."

Being assured that the installation of drainage for the Gezira was quite a small matter, fully foreseen in the development of the project, I could do no more than await the course of events. How much those events belied anticipations may be measured by another answer.

> "The average yield (per acre) has been taken as 300 lbs., and that, I think, is a very safe figure."

It is not necessary to discuss the later phase of intensive research on the soil, hampered by the soil-effects being masked under the

incidence of disease, which liability to disease is often a mere secondary consequence of unhealthy root conditions. The Howards dealt with indigo disease in Bihar on those lines nearly twenty years ago. Even the attack of green-fly on cotton can be correlated with subsoil structure under certain circumstances. The pivotal result during this later phase is the graph of soil-water-content profiles, published by Greene in the *Journal of Agricultural Science*, which not only defines the restricted conditions of root-development, but shows the natural drainage conditions of the soil to be much worse than I had ever expected, and increases the likelihood that—

> "in addition to common salting, there are other chemical possibilities in such undrained patches, all resolving themselves into the slow accumulation of chemical compounds antagonistic to plant growth, and thus leading to slow deterioration which no manuring can affect. Such accumulations can only be abolished by removal in the drainage-water, before or after chemical treatment."

And today we must add, regretfully, that some of these changes are irreversible, so far as our present knowledge goes.

So we come to the practical proposition at last. Is it feasible, as a problem in civil engineering, to drain the Gezira soil? We possess there a weathered skin on the surface of a clay which will scarcely admit water at all, and when it does admit any it swells so much that it breaks houses standing upon it. And I think we may dismiss the expert opinion previously quoted, that the job will be small and easy: there will be nearer fifteen than five cubic metres in those drains at some seasons, if we can get any water there at all. The financial side is practicable, by employment of reserves in reclaiming areas successively over a period of years, and temporarily over-cropping those areas with the cash crop when reclaimed. The cost of an installation of field drains is not prohibitive, but what is not known is, would they work in the Gezira soil, if suitably designed and laid and operated? Nor is it known (even if they would give us a healthy top layer, 70 cm. thick) whether such a shallow soil could grow good cotton under Sudan climatic conditions, with consistency. But the only way to find out is by trial, and the word "trial" is used advisedly in place of the word "experiment." Such a trial must be done on a civil engineering scale to be of any real value, preferably in more than one locality, and upon 100 acres at each. Experiments, as such, are not needed, except in the form of practical engineering.

There is only one form of field drainage known to us at present

which stands any chance of working successfully in the Gezira soil —namely, the system devised for the silt and clay of Egypt by G. H. Dempster. Essentially this consists in providing a small but carefully made filter-bed at each of all the butt-joints of the drain-pipes, which, incidentally, are made on the spot from concrete. Ordinary tile drains are notorious failures even in Egypt; brushwood drains are far worse; and any attempt at mole drainage is doomed before starting. Dempster-type drains, on the other hand, have been running clear since 1922 on the Egyptian State Domains near Belcas, giving better results than the open drain which is conventional practice in Egypt, requiring no attention for clearance and re-grading, and economizing the surface area lost when open drains are used.

There are two unanswered questions about the employment of these drains in the Gezira. Would the subsoil allow them to stay in alignment if the trenches were opened in advance and well weathered, watered, and regraded before the actual pipes were laid? Would the reclamation, confined at first to the over-fill immediately above the pipes, work sideways at a sufficiently rapid rate to effect full reclamation in a reasonably small number of years? There can be no question that the reversal of direction of water movement and the continual ingress of oxygen to the soil would reverse some, even if not all, of the chemical and physical actions which have been intensified since the land was put under irrigation: the practical question is, how quickly?

It is not difficult to visualize the situation underground. Every stream-line of water and oxygen established would sooner or later improve the permeability of the soil contiguous to it, and this in its turn would become a line of flow. It is only in terms of some such compound-interest system that we can account for the results obtained in Egypt.

At present there seems no likelihood of setting the pipes at greater depths than 70-80 cm., shallow though this is. But one might justifiably contemplate the insertion between these, at a later date, of drains at the more reasonable depth of 140-150 cm. With such a depth of good soil, the Gezira might be an important cotton area.

There is one minor experiment recorded in recent years, which must be mentioned explicitly, otherwise it might be regarded as a complete refutation of our views. This experiment was one in which a complete water-logging of plots gave a markedly increased yield, while all duties of water lower than this gave equally lower yields.

To this experiment one must apply the artist's dodge of looking at it upside down; then it provides the clearest evidence for avoiding water-logging. When the roots could develop near the surface without desiccation, they were sufficiently far away from the injurious salts and toxic substances in the lower layers of the soil, and yet were adequately aerated. Which is precisely the condition we obtain at all depths in a well-drained soil.

And, in conclusion, this leads to the inference that when the Gezira soil is drained (if it can be), all the research work on it will have to be done again, especially with respect to the manure-water relationship. The economy of water effected by drainage will in itself be enough to pay for such research.

Received November, 1934.

THE CYTOLOGICAL STUDY OF COTTON AND ITS RELATIVES

The following letter has been received from Mr. J. B. Hutchinson, of the Institute of Plant Industry, Indore. Dr. Gates's memorandum in reply is also printed.—ED.

INDORE,
CENTRAL INDIA,
August 9, 1934.

DEAR MR. EDITOR,

As one who has recently migrated from the clear and rarefied atmosphere of pure genetics to the thick and dusty air of practical plant breeding, I may perhaps be accused of being sensitive, but I was somewhat amazed to read the statement in Prof. Gates's article in your July number that: " Without high-power microscopes and the knowledge of chromosomes which they have brought, plant breeding would long since have reached its limits and have been reduced to purely empirical and rule-of-thumb methods . . ." Prof. Gates has, I fear, put the less before the greater. Perhaps he has forgotten that he always has to use a microscope to magnify the less. The chromosome theory of inheritance is only a part of the more general theory which Prof. Fisher has termed the particulate theory of inheritance. It is with the exploration of the more general theory that the plant breeder is concerned. I have for interest looked up the chapter on " The Nature of Inheritance," in R. A. Fisher's " Genetical Theory of Natural Selection," and I may quote his general conclusion (p. 8): " It thus appears that, apart from dominance and linkage, including sex linkage, all the main characteristics of the Mendelian system flow from assumptions of particulate inheritance of the simplest character, and could have been deduced *a priori* had anyone conceived it possible that the laws of inheritance could really be simple and definite." Referring to the discovery of linkage, he says (p. 9): " The conceptual framework of loci must therefore be conceived as made of several parts, and these are now identified, on evidence which appears to be singularly complete, with the dark staining bodies or chromosomes which are to be seen in the nuclei of cells at certain stages of cell division." This, I find, is the only reference to cytology in the whole chapter!

The plant breeder has, in many cases, allowed himself to become a rule-of-thumb worker because he has failed to realize the importance of accumulating scientific evidence on the particulate theory of inheritance *which his own material offers him*, and not because he is isolated from contact with the cytologist and his microscope. Since I became a plant breeder I have had

frequent cause to lament this scientific inferiority-complex on the part of plant breeders in general, and their consequent neglect of golden opportunities of investigating their own most important problem and the most neglected branch of modern genetics, the inheritance of quantitative characters.

It seems to me of doubtful advantage to show the plant breeder how to increase the number of loci in a genotype when he has not yet studied the laws governing the behaviour of those already at his disposal.

Coming to the portion of Prof. Gates's paper which deals more specifically with cotton, another of my fond illusions is shattered by the statement that differences made evident by measurements are not to be trusted if they are not clear to the eye. However, if I understand Skovsted's paper aright, he deduces the homology of half the New World chromosome complement with the Asiatic complement much more certainly from a comparison of chromosome congregation in an Asiatic triploid with that in Asiatic New World hybrids than from the observed differences in size.

Answers are already available to some of Prof. Gates's speculations on the origin and history of New World cottons. Post-Columbian origin for 52 chromosome types is pretty well ruled out by the facts that there are no 26 chromosome cottons known in the New World which have any lint which the Peruvian natives could have spun; there are species of cotton endemic in the Galapagos islands which are freely fertile with 52 chromosome cottons (I do not know whether their chromosome numbers have been determined), and a 52 chromosome cotton is endemic in Hawaii. Also, it is inconceivable that a group of plants of the range and variability of the New World cottons should have arisen in the space of four centuries and left us ignorant of the fact.

Evidence of polyploidy from the occurrence of multiple factors should be treated with caution. There are at least four factors for lint length in Asiatic cottons, no one of which is responsible for more than 5 to 10 per cent. of the genetic variance of the character. I know of at least four factors for lint colour, and as many for petal length in Asiatic cottons. There is, however, no suggestion of octaploidy in Asiatic cottons, and actually of the whole collection only two factors for lint colour are really duplicates of each other. If such factors as those for lint length are to be regarded as duplicates, what will the cytologists make of "Student's" calculation, that there may be as many as 200 factors affecting oil content in maize kernels?

In conclusion, Mr. Editor, and fellow plant breeders, the cytologist is engaged on a great task, which I do not wish to belittle, and one day he will give us a great deal of help, but meanwhile we still have a good many urgent problems to solve.

Yours sincerely,
J. B. Hutchinson.

The following memorandum in reply has been received from Dr. Gates:

"In my remarks I wished merely to emphasize the importance of combining a knowledge of the cytology of any particular crop with plant-breeding experiments if wide-reaching results are to be obtained. I had no desire to develop an inferiority complex in plant breeders, nor have I ever seen any indications of such a psychological condition in those I have met. But since Mr. Hutchinson has raised the matter, I think it is desirable to point out that the history of the development of scientific work in British Dominions and colonies overseas shows that the British worker has too often found it easier to take up immediate objectives for crop improvement than to launch out on a wider programme of fundamental research, which would in the end have yielded much more valuable practical results.

"It is quite likely, however, that the fault here lies more with the administrative element, whose task it is to provide the necessary facilities, than with scientific investigators themselves, who are frequently encouraged by conditions to set out only for limited objectives. In this respect a lesson might well be learned from the scientific activities of the Dutch in the East Indies. Their research on such crops as sugar-cane, rubber, and the oil-palm has often been fundamental in character, and shows that a purely scientific approach on a sufficiently broad front reaps an abundant reward in the long run. This is not, however, to suggest that there should be no difference between the aims of pure and applied science, but rather to point out that those with *purely* limited and immediately practical aims are likely to be left behind by those who are not afraid to tackle and develop any new problem as a fundamental research in science.

"By the statement which Mr. Hutchinson quotes, I did not mean to imply that without continued use of the microscope there would be nothing left for the plant breeder to do, but rather that for further advances in genetical *principles* the co-operation of the cytologist and the breeder is essential. In the past, most of the discoveries of new principles since Mendel's original experiments have been based upon cytological observations, combined in some cases with breeding experiments. Once these principles have been discovered the breeder naturally makes use of them, but he only narrows his outlook by disregarding the source from whence they came. It is true, of course, that de Vries discovered the great principle of mutations without the aid of cytology, but without decades of cytological investigation we would have had no analysis of the many different types of mutations which are now known to exist. It cannot be denied that a knowledge of these is of great service in plant breeding, and it is clear that no proper analysis of mutational processes could have been made in the absence of cytological research.

"Mr. Hutchinson apparently wishes to minimize the significance of cytology in genetical research. When he reminds me that chromosomes require high magnification to make them visible he is using the very unscientific argument that the importance of a thing depends upon its size. I am sure that with a little thought he would repudiate this idea. Apparently with the same aim he quotes Fisher's important work, and remarks on the fact that in his chapter on 'The Nature of Inheritance,' Fisher only refers to chromosomes once. This was possible because the chromosome mechanism of inheritance is so extremely general in character. Had the genetics of particular genera of plants been considered, the chromosomes would soon have emerged as the basis for explaining a great deal of the aberrant behaviour which cropped up. Incidentally, the term 'particulate theory of inheritance' did not originate with Professor Fisher, but goes back to Galton.

"Mr. Hutchinson refers to quantitative inheritance, a subject to which he has made important contributions, and seems to imply that it has been neglected by plant breeders because of an inferiority complex. I agree with him that there is room foı an immense amount of valuable practical work in this field, although it appears to be one in which cytology can directly contribute very little. My own interest in this field may perhaps be gathered from the fact that for five years we were engaged in such investigations, involving over 150,000 measurements, although the results are as yet mostly unpublished.

"Mr. Hutchinson has misquoted me as saying that 'differences made evident by measurements are not to be trusted if they are not clear to the eye.' He will probably concede that I have had more experience in measuring chromosomes than he, and that I am therefore better aware of the range of variation in chromosomes and the great technical difficulties in proving that a constant size-difference exists when it is so small as to be unappreciable to the eye. This is what I had in view in pointing out the necessity for more evidence before accepting it as proven, that the New World cottons have smaller chromosomes than the Asiatic species.

"If, as seems highly probable, the tetraploid cottons arose in America before that continent was discovered, then it is unlikely that an Asiatic cotton was involved in the ancestry. That being the case, American wild species, perhaps at present unknown, may be reasonably expected to have produced the tetraploid cottons, either under aboriginal cultivation or under natural conditions. On the other hand, when one considers the obscurity and indefiniteness of nearly all the early botanical determinations of cotton, it is not quite so 'inconceivable' as Mr. Hutchinson thinks, that the tetraploid forms *might* have arisen in post-Columbian times. It is clearly not necessary that all of them should have come from a single source or a single ancestral cross.

"As Mr. Hutchinson indicates, there is at present very little satisfactory evidence of multiple factors in cotton. Nevertheless, the possibility of their future occurrence needs to be kept in mind. As regards 'Student's' calculation of 200 factors for oil content in maize kernels, that is little better than a guess, and all statisticians are at present agreed that the mathematicians have not yet produced a method by which the number of quantitative factors involved in any series of size measurements can be determined. Such a method, if available, would be a great boon.

"Although I have traversed some of Mr. Hutchinson's statements, this in no way detracts from my appreciation of the valuable genetical work he has done. There is plenty of scope for both plant breeding and cytology, and the aim of my original article was to point out how both derive strength from co-operation. Mr. Hutchinson's important contributions on size-inheritance have required no assistance from the microscope; but he has described cases of linkage with other characters, and even here the chromosome theory comes in to assist him.

R. R. Gates.

King's College,
University of London.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

EVENTS in the cotton world since our last issue may be described as the aftermath of the extraordinary developments with regard to the American crop which we described in that issue. The table of the American crop on page 47 shows that no substantial change has taken place in the position of the crop; it has simply benefited by the slight but steady improvement which marks the normal course of an American crop throughout the season when no exceptional circumstances arise. The drought broke in August and, as it turned out, it was not too late to allow of some improvement in the drought-stricken areas of the West, and as the weather in the rest of the Belt has been normally favourable, the crop figure has increased by 536,000 bales since August. The acreage was slightly reduced in September, because the actual abandonment turned out to be a little more than the ten years' average on which the August figure is based, but in December the revision of the acreage planted and harvested resulted in a considerable increase of both, but a further rise in the percentage of abandonment.

As will be seen from the table of the World's Cotton Crops on the same page Outside Growths had already in 1933-34 shown a remarkable recovery. The revised figures given in that table show that the total was a substantial increase on the previous record of 13,069,000 bales in 1928. The percentage of Outside Growths on the total, including linters (49·6 per cent.), exactly equalled the previous record of 1921 when Outside Growths were 8,233,000, but owing to the boll weevil the American figure was only 8,351,000, including 397,000 of linters. If the linters were excluded, the percentage of Outside Growths on American in 1933 would be 105·7 against 103·5 in 1921, so that 1933-34 is a new record in every way.

But all that is nothing to what is likely to happen in the new season with the American crop reduced below 10 million bales and Outside Growths probably showing a slight increase on last year's record figure, say to 14 million bales. That would make Outside Growths about 145 per cent. on American!

The principal changes in the World's Crops table since it last appeared in July are: (1) The new record figure for Brazil in 1933 and the still higher prospective figure for the current season. As a matter of fact estimates of the 1933-34 crops are as high as 969,000 bales, but the figure we are using is the mean of various estimates. (2) For Egyptian we are now using the Government's final revised figure of the actual growth for each season based on the final ginning returns, instead of the figures of the Alexandria Bourse authorities which were based on the Adjusted Arrivals during each season, and therefore represented the commercial crop rather than the actual growth of the season.

The latest information available with regard to the Egyptian crop for the coming season is given in our first table on page 48. It will be seen that the Government's estimate of acreage is slightly less than last year's figure, but that is said to be due to closer supervision of the estimate by the Survey officials. The details of the area according to varieties in 1934 were given in the October issue. The revised estimates of the Government and the Alexandria authorities have greatly reduced the earlier disparity between these two, which was due to the fact that the first estimates were separated in time by about a month, and that during that period the crop prospects had materially deteriorated.

The abnormal position shown by the World's Crops table with regard to the production of American and Outside Growths respectively is paralleled by the movement of Consumption. The details of the Federation statistics are given in the first table on page 49, but the gist of them had already been given in the October issue. There are, however, several points of interest in the details. It will be seen that the reduced consumption of American last year was most marked in America itself and in Asia, but even in the U.K. and on the Continent, where the season's total was higher, the decline was very marked in the second half of the season as against the first. The increase in the consumption of Outside Growths, on the other hand, applied to all the varieties, Indian, Egyptian, and Sundries, and to almost every major division of the industry, with the curious exception that the U.K. used less Sundries during the year and also used less Egyptian in the second half than the first. It will be noted that the consumption of Egyptian for the season was a substantial new record.

The second table on page 49 gives the details of the U.S. consumption monthly during the past season and for the first three months of the new season. The latter details are important because

they show that even in August a considerable recovery had been made in spite of the 25 per cent. restriction which came to an end on 24th August. But this was very promptly followed by a nation-wide textile strike which caused a still heavier reduction in September. It may be noted in passing that this was not actually a new low record, for in July, 1932, it was 278,568 bales. October, however, showed a substantial recovery and made the total the best figure since May.

To this may be added Garside's preliminary estimates of the world consumption of American and Outside Growths for the first three months of the season, which are 2,905,000 bales of American and 3,099,000 of Outside Growths.

The position of the World's Carryover of American cotton at the end of the season was dealt with in our October issue. This time we give on page 48 the figures of the Egyptian Carryover. The main point of interest is that the total at the end of the season has again been slightly reduced, which was rather against expectations, for with a crop of 8,575,000 kantars and world's consumption of 1,108,000 bales (equivalent to about 8,300,000 kantars) there should have been a small addition. Such discrepancies, however, between the calculated carryover and the actual computation are far from unusual.

We have frequently stressed in these statistics the interrelation between production, consumption and prices, and the two tables of prices which we give on page 50 are therefore of special interest. Taking first the record of Futures prices of American in New York and Liverpool, it will be seen that both markets touched a new high record in the first month of the new season as the result of the low crop figures, assisted by the fact that in August the American Government announced its willingness to lend up to 12 cents per lb. for Low Middling at Southern points, which is believed to be equivalent to about 12½ to 13 cents for Middling in New York. But that high level has not been sustained in spite of the Government "peg," because the markets had apparently assumed that the Government's scheme of restriction of acreage would be very substantially modified in 1935 and that there would be no loan system next season. On 29th November, however, the Government announced that the maximum reduction of 25 per cent. in the basic acreage would be enforced in 1935.

With regard to Egyptian prices, it will be seen that these on the whole followed American until October, but towards the end of that month they made a marked recovery, largely as the result of the settlement of the dispute with Germany and the withdrawal of the embargo on yarn exports, which, of course, was particularly beneficial to Sakel, so that in November new high levels were touched for Sakel.

The table of Liverpool Spot prices of other varieties shows the effect of the inflation of American cotton on the relative prices of other varieties. It will be seen that as percentages on American all the other varieties (except East African) have declined still further since the beginning of the season, but November has reversed the trend for Indian as well as Egyptian.

For ease of reference we repeat the list of tables given last year, showing the issues in which each will appear:

	January.	*April.*	*July.*	*October.*
World's Crops	×	—	×	—
American crop	×	—	×	×
Indian crop	—	×	—	×
Indian crop by varieties	—	—	×	—
Egyptian crop	×	—	×	—
Egyptian crop by varieties	—	—	—	×
Sudan crop	—	×	—	—
World's consumption (Federation) ...	×	—	×	—
World's consumption (Garside)	—	×	—	×
U.S. consumption	×	×	×	×
World's Carryover, American	—	×	—	×
World's Carryover, Egyptian	×	—	×	—
Futures prices, American and Egyptian ...	×	×	×	×
Spot prices, other varieties	×	×	×	×

WORLD'S COTTON CROPS.
(Bales of 500 Lbs.—000's).

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35. (Estimates)
U.S.A. Lint	14,825	13,932	17,096	13,002	13,047	9,731
Linters	1,241	986	1,067	912	950	900
Total	16,066	14,918	18,163	13,914	13,997	10,631
Mexico	240	174	206	99	220	194
Brazil	564	470	558	396	810	1,200
Peru	266	243	226	234	270	265
Argentine	138	150	165	152	162	160
Other South American	66	52	39	43	51	60
India*	5,243	5,224	4,007	4,656	4,970	5,000
China	2,055	2,317	1,733	2,228	2,700	2,927
Japan and Korea ...	137	150	98	132	188	200
East Indies, etc. ...	18	18	15	13	13	15
Russia	1,279	1,589	1,846	1,750	1,890	1,650
Persia	73	72	110	100	100	100
Iraq, Ceylon, etc. ...	4	3	1	†	†	†
Asia Minor and Europe	143	119	131	68	103	151
Egypt	1,706	1,655	1,271	991	1,715	1,560
Sudan	127	96	188	110	131	135
East Africa (British)	131	166	182	266	252	260
South Africa (British)	14	8	3	2	3	3
West Africa (British)...	35	15	5	20	20	20
Non-British Africa ...	121	128	94	127	150	150
West Indies (British)...	4	4	2	2	2	2
West Indies (Others) ...	25	21	30	26	25	25
Australia, etc.	12	10	4	11	16	16
World's Total ...	28,467	27,602	29,077	25,340	27,788	24,724
Outside Growths ...	12,401	12,684	10,914	11,426	13,799	14,093
Per cent. on Total ...	43·6	46·0	37·5	45·1	49·6	57·0

Government Estimate, 400 lb. bales. † Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1934–35.
Acreage planted (000's)	43,735	44,458	43,339	39,109	36,542	40,852*
Acreage harvested ...	42,432	43,242	42,454	38,705	35,939	29,978
Crop (running bales)...	14,297	14,548	13,756	16,629	12,710	12,664
Yield per acre (lbs.) ...	163·3	164·1	157·0	211·5	173·3	208·5
Season's average spot price (Liverpool—pence per lb.) ...	10·52	9·09	5·71	4·82	5·62	6·02

Progress of the Season 1934–35.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	28,024	28,024	28,024	28,024	28,412	
Acreage harvested ...	27,371	27,241	27,241	27,241	27,515	
Crop (500 lb. bales) ...	9,195	9,252	9,443	9,634	9,731	
Yield per acre (lbs.)...	160·9	162·6	165·9	169·3	169·2	

* Less 10,396,000 acres special abandonment.

EGYPTIAN CROP.

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.
Area (feddans, 000's) ...	1,841	2,082	1,683	1,094	1,804	1,732
Crop (kantars, 000's):						(Estimates)
Alexandria adjusted arrivals	8,485	7,947	6,563	5,050	8,438	7,540
Government figures*	8,531	8,276	6,357	4,956	8,575	7,801
Average yield (kantars per feddan)*	4·63	3·97	3·78	4·53	4·75	4·50

Season's Average Spot Prices (Liverpool—Pence per Lb.).

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.
Sakel	14·52	9·06	6·80	7·79	8·05	
Percentage on American	59·7	33·6	41·1	38·6	33·7	
Uppers	10·47	6·86	5·68	7·01	6·64	
Percentage on American	15·2	20·1	17·8	24·7	10·3	

* Final revised figures, including Scarto.

WORLD'S CARRYOVER OF *EGYPTIAN* COTTON
(KANTARS 000's).

End of	*Stock and Afloat.*		*U.S.A.*		*Alexandria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.**
	U.K.	*Continent.*	*Mills.*	*Warehouses.*				
1929, July ...	510	150	449	197	1,677	2,983	1,260	4,243
1930, January	*585*	*270*	*353*	*202*	*3,403*	*4,813*	*1,335*	*6,148*
July ...	353	135	483	245	3,616	4,834	1,297	6,131
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,185*	*7,927*
July ...	600	165	212	108	4,456	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8,437*
July ...	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*169*	*4,255*	*5,654*	*1,425*	*7,079*
July ...	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	*1,507*	*337*	*143*	*106*	*3,157*	*5,250*	*1,687*	*6,937*
February	1,455	232	143	111	3,011	4,952	—	—
March	1,373	293	155	127	2,922	4,870	—	—
April ...	1,425	270	166	138	2,654	4,653	—	—
May ...	1,335	203	169	152	2,332	4,191	—	—
June ...	1,208	225	168	143	1,956	3,700	—	—
July ...	1,132	248	174	135	1,491	3,180	1,868	5,048
August	1,050	195	178	128	974	2,525	—	—
September	998	203	173	131	1,229	2,734	—	—
October	990	232	160	112	1,966	3,460	—	—
November	1,027	330	—	—	2,049	—	—	—

* Figures in *italics* to distinguish between Mid-Season and end of Season.

WORLD'S CONSUMPTION OF COTTON.

(FROM THE STATISTICS OF THE INTERNATIONAL FEDERATION.)

(*Running Bales, 000's—Excluding Linters.*)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals.*
American.	1928–29	1,910	4,614	6,778	1,431	333	15,066
	1929–30	1,474	4,055	5,803	1,427	256	13,015
	1930–31	991	3,242	5,084	1,345	239	10,901
	1931–32	1,342	3,343	4,744	2,636	251	12,316
	1932–33	1,400	3,836	6,004	2,655	276	14,171
	1933–34	1,461	3,976	5,554	2,238	306	13,535
Indian.	1928–29	183	1,150	35	3,766	44	5,178
	1929–30	188	1,375	61	4,403	60	6,087
	1930–31	252	1,215	43	4,318	35	5,863
	1931–32	183	727	21	3,834	23	4,788
	1932–33	126	600	16	3,455	23	4,220
	1933–34	234	844	14	3,638	42	4,772
Egyptian.	1928–29	365	401	155	43	25	989
	1929–30	301	415	137	58	26	937
	1930–31	242	420	70	96	25	853
	1931–32	301	480	53	120	26	980
	1932–33	301	442	58	104	29	934
	1933–34	366	515	69	119	39	1,108
Sundries.	1928–29	342	1,947	55	1,480	815	4,639
	1929–30	502	2,044	51	1,825	740	5,162
	1930–31	479	1,984	42	1,648	711	4,864
	1931–32	560	1,730	26	1,133	786	4,235
	1932–33	421	1,797	32	1,922	856	5,028
	1933–34	409	2,137	33	2,154	964	5,697
All kinds.	1928–29	2,800	8,112	7,023	6,720	1,217	25,872
	1929–30	2,465	7,889	6,052	7,713	1,082	25,201
	1930–31	1,964	6,861	5,239	7,407	1,010	22,481
	1931–32	2,386	6,280	4,844	7,723	1,086	22,319
	1932–33	2,248	6,675	6,110	8,136	1,184	24,353
	1933–34	2,470	7,472	5,670	8,149	1,351	25,112

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000's: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1933–34.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
August ...	588·6	25·6	571·3	1·2	11·3	4·8	83·3
September ...	499·5	24·1	485·7	0·9	9·2	3·8	76·5
October ...	503·9	23·2	489·0	1·1	9·6	4·2	66·8
November ...	475·4	22·1	461·8	0·9	9·0	3·6	59·1
December ...	348·4	19·4	338·9	1·1	6·2	2·2	51·6
January ...	508·0	22·3	493·8	1·1	10·2	2·9	57·8
February ...	477·9	24·2	463·8	1·5	9·3	3·3	59·7
March ...	543·7	24·7	527·9	1·3	10·7	3·8	74·5
April ...	512·7	24·4	499·1	1·1	8·6	4·0	67·8
May ...	519·8	22·8	507·1	1·0	7·4	4·3	63·9
June ...	363·4	17·3	352·9	1·0	6·3	3·2	55·0
July ...	359·4	17·1	349·7	0·6	6·1	3·0	63·0
1934–35.							
August ...	420·9	18·3	409·4	0·8	7·8	2·9	61·2
September ...	296·0	15·0	289·3	0·3	4·5	1·9	54·7
October ...	520·3	22·9	506·6	0·9	10·4	2·5	57·4

HIGHEST AND LOWEST FUTURES PRICES.

1933–34.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
August ...	10·66	*8·47*	6·12	5·22	8·02	7·00	7·21	6·33
September	10·71	8·94	5·58	5·15	7·34	6·84	6·46	6·01
October ...	10·08	8·83	5·47	5·15	7·21	6·79	6·26	5·91
November	10·30	9·41	5·29	*4·78*	7·08	*6·52*	5·99	*5·44*
December	10·29	9·96	5·20	4·96	7·55	6·78	5·99	5·67
January...	11·49	10·30	5·93	5·19	8·42	7·57	6·58	5·99
February	12·54	11·53	6·48	5·92	*9·25*	8·36	7·23	6·61
March ...	12·38	11·71	6·40	6·04	8·91	8·35	6·99	6·69
April ...	12·23	10·86	6·14	5·62	8·62	7·90	6·80	6·18
May ...	11·59	10·70	6·05	5·57	8·37	7·88	6·63	6·14
June ...	12·52	11·61	6·55	5·94	8·48	8·22	6·98	6·55
July ...	*13·35*	12·03	*6·97*	6·28	8·60	8·10	*7·31*	6·75
1934–35								
August ...	*13·84*	12·97	*7·23*	6·77	8·71	8·29	7·54	7·19
September	13·43	12·35	7·00	6·57	8·65	7·87	*7·59*	7·02
October ...	12·53	*11·96*	6·70	*6·43*	8·21	*7·65*	7·19	*6·74*
November	12·66	12·02	6·80	6·45	*8·85*	7·99	7·58	6·97

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1933–34.	*American (Middling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil Pernam (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
August ...	5·53	79·6	101·3	103·1	115·7	124·8	122·4	136·0
September	5·60	80·7	100·9	103·6	114·3	124·1	114·6	132·0
October ...	5·54	78·3	100·0	102·7	113·5	122·6	111·0	127·4
November	5·09	77·6	100·0	102·9	114·7	120·6	112·6	137·7
December	5·33	75·6	100·0	100·9	114·1	124·4	113·5	145·2
January ...	6·07	74·0	99·2	99·2	111·5	120·6	109·9	140·4
February	6·67	73·2	98·5	97·8	107·5	118·0	107·9	136·6
March ...	6·35	70·1	98·4	94·5	107·9	118·9	108·0	137·6
April ...	5·88	70·9	100·0	94·9	109·4	121·3	106·5	137·2
May ...	6·20	75·2	99·2	95·2	108·9	120·2	107·6	135·8
June ...	6·84	73·2	99·3	95·6	107·3	118·3	102·8	122·1
July ...	6·97	72·5	98·6	96·4	106·5	117·2	104·0	122·0
Season's average	6·02	75·1	99·5	98·8	110·8	121·4	110·3	133·7
1934–35.								
August ...	7·11	70·5	99·3	96·5	105·6	116·2	105·1	122·9
September	6·91	69·8	99·3	96·4	106·5	116·6	103·9	121·7
October ...	6·92	68·1	98·6	95·7	107·2	114·5	105·2	118·8
November	6·96	70·7	98·1	95·3	106·8	114·7	108·8	129·3

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

1. The following reports have recently been received:
Ann. Rpt. of Indian Merchants' Chamber, 1933.
Rpt. of the Indian Trade Commissioner, 1933-34.
PUSA: Sci. Rpts. of Imp. Inst of Agr. Res., 1932-33.

2. REPORT ON THE WORK OF THE INDIAN TRADE COMMISSIONER DURING 1933-34. By Sir H. A. F. Lindsay. This report contains much useful information under the following heads: Modern trade tendencies; Agricultural products—food-stuffs and industrial materials; Indian timbers; Lac and shellac; Indian minerals; Trade publicity; Committees and conferences; Staff and acknowledgments. Various appendices are also included. During the period under review the United Kingdom's imports of cotton from India increased; in fact, the imports during January-March, 1934, from India, were more than three times what they were during January-March, 1932. Close contact was maintained throughout the year with the Lancashire Indian Cotton Enquiry Committee, the object of which is to increase the use of Indian raw cotton in the United Kingdom.

3. INDIAN CENTRAL COTTON COMMITTEE. At the 29th meeting, held on August 28, the following important matters were discussed: The immediate need for legislative measures to rid the cotton industry of the prevailing malpractices of watering and mixing of cotton; the cultivation of improved varieties of cotton in the barrage areas of Sind; the campaign for extension, seed distribution, and marketing of pure Sind-American cotton; and the future policy to be adopted in the case of the Institute of Plant Industry, Indore. The various research schemes financed by the Committee were reviewed, one scheme being extended for a further period and four new schemes sanctioned. The Progress Report of the Director of the Technological Laboratory at Matunga dealt with the spinning tests conducted at the Laboratory during the seven months under report. It was decided at the meeting to make the Publicity Department a permanent adjunct of the Committee.

4. INDIAN CENTRAL COTTON COMMITTEE. We have received from the Publicity Officer the following notices:

Note on the Improvement of Cotton in Sind. Before the opening of the Lloyd Barrage Sind had about 300,000 acres of cotton, with 100,000 bales outturn. In 1933 the acreage was 500,000, and it is expected to expand to 750,000. There are four main classes of cotton—viz., Sind Deshi, Punjab-Americans, Imported Americans, Imported Egyptians. Improved strains of all have been produced, the breeding being largely for hardiness (in the Sind climate) and vigour. The improved strains are described, and are being tested on a large scale with the aid of a grant from the Indian Central Cotton Committee, which is also financing the seed multiplication scheme.

Madras Herbaceum Scheme. This scheme, financed by the Indian Central Cotton Committee, has for its object the breeding of a suitable strain for the black soils of the southern districts of Madras which will possess the yield, ginning, and spinning qualities of Karunganni, combined with the colour and root system of Uppam cotton. The results so far obtained are discussed.

Madras Cholam Fodder Scheme. The results obtained to date by this scheme, financed by the Indian Central Cotton Committee, indicate that (*a*) when cholam is harvested at the flower stage there is no fall in the yield of the succeeding cotton; (*b*) early opening up of the soil improves conditions for cotton succeeding cholam.

money crop even at present prices. Experiments were continued at the various Experiment Stations to determine and demonstrate the most suitable variety for the different districts and the best method of cultivation. In regard to the Pure Line Seed Supply Scheme, Ambalantota, towards the end of the year definite action was taken for the early outlay of a 60-acre station within the boundaries of the former Cotton Experimental Station. This most necessary provision had been held up for some years owing to the uncertainty regarding a water supply.

16. CYPRUS: *Cotton Cultivation*, 1933. (*Ann. Rpt. Dpt. of Agr.*, 1933.) Owing to the lack of irrigation water the area sown was much reduced. Dry cotton also suffered from lack of rain. Demonstrations to show the effect of early planting on the reduction of pink bollworm infestation were carried out at Akanthou, and it was shown that cotton-growers could increase their production considerably were the value of early planting more generally realized. *Aphis gossypii* was the only cotton pest encountered during the year. No serious disease was reported, but *Rhizopus arrhizus*, Fischer (determined at the Imperial Mycological Institute), was found causing a rot of unopened cotton bolls at Kythrea.

17. AFRICA. ECONOMIC CONDITIONS IN EAST AFRICA, 1932-34. By C. Kemp. (No. 583, Dept. of Overseas Trade.) We have received a copy of this report from the Dept. of Overseas Trade. The economic position in Uganda, Kenya, Zanzibar, and Tanganyika Territory is discussed, together with questions of public finance. Considerable attention is also devoted to the import and export trades, and particulars are given regarding railways, harbours, shipping, and airways. Various statistical appendices are included relating to trade and shipping. A memorandum on the financial and economic position of the Somaliland Protectorate for the years 1932-33 (C. H. F. Plowman) is also included in the report.

18. GOLD COAST: *Cotton Cultivation*, 1933-34. (*Rpt. of Dpt. of Agr.*, 1933-34.) The cotton crop in the Southern Togoland area was a comparative failure, owing to an exceptionally wet and prolonged rainy season, accompanied throughout the year by a series of destructive tornadoes. Serious flooding also occurred on low-lying ground. The export of seed cotton over the frontier was only some 30 tons, compared with an average of 86 tons for the previous three years. The cultivation of the 20 half-acre blocks of Improved Ishan cotton in various parts of the area was discontinued, as farmers have now satisfied themselves of the superiority of this type over the local variety, and plant up their own supply, large areas being grown as a pure stand in the Vakpo and Ve Districts. In the adverse circumstances of the season it was not possible to make much headway with the formation of Cotton Growers' Co-operative Societies, little capital being available.

In the Northern Territories the improved strain D28 continued to yield well under proper cultivation. In rotation trials, unmanured, a mean yield of 353 lb. per acre seed cotton was obtained, whilst in manurial trials a dressing of 6¼ cwt. per acre balanced artificial manures gave 421 lb. per acre.

19. KENYA: *Cotton Cultivation*, 1933-34. (*Econ. Condns. in E. Africa*, 1932-34. [C. Kemp].) The season's crop is estimated to yield 4,000 bales, as compared with 3,037 bales in 1932-33. The increase is mainly due to the energetic measures taken to revive native agriculture in the coastal districts, although the lake district has also shared in the improvement.

20. NIGERIA. *Northern Provinces: Cotton Investigations.* (*Bull. Imp. Inst.*, xxxii., 2, 1934, p. 299.) The report of the Botanical Section, Department of Agriculture, for the half-year July 1 to December 31, 1933, contains the following account of experiments with cotton:

Cotton Seed Disinfection. An experiment was carried out to determine the effect on yield of disinfecting the seed with a mixture of 1 per cent. Germisan and 0·2 per cent. soap for ten minutes, so as to destroy *Bacterium malvacearum.* The disinfectant had an adverse effect on the viability of the seeds, so that there was a difficulty in getting a stand on the treated plots, the final stand being 8·4 per cent. less than the control. Moreover, there was so little bacterial disease on the control plots that it was impossible to distinguish them from the treated plots.

Variety Trial. The results of a trial of S.G.27, U.4/123 and Allen (seed from Zaria ginnery) were very favourable to S.G.27, and unfavourable to U.4/123, which was found to be generally inferior to Allen. S.G.27 is a strain isolated by the Agricultural Department in Uganda, and U.4/123 is one isolated by the Agricultural Department in Southern Rhodesia. Allen was introduced from Uganda in 1912.

21. NYASALAND: *Cotton Ordinance.* From a recent report received from H.M. Eastern African Dependencies, Trade and Information Office, we learn that at the fiftieth Session of the Legislative Council held on October 24-25, the Cotton and Tea Bills were passed. The Cotton Ordinance is designed to secure the production of the highest quality of cotton by generally controlling the local industry.

22. SOUTHERN RHODESIA: *Further Notes from the Cotton Station, Gatooma.* By J. E. Peat. (*Rhod. Agr. J.*, xxxi., **9**, 1934, p. 665.) The work with improved U.4 strains at Gatooma is discussed. Two derivatives of U.4/64 (Gatooma 5), the outstanding parent stock—viz., U.4/64/7/10 (Gatooma 5, 11) and U.4/64/V (Gatooma 5, 21)—yielded in bulk 800-900 up to 1,200 lb. seed cotton per acre, while some newer improved U.4/64 strains were yielding even better. Notes are included on trap crops for American bollworm, spacing, soils, fertilising, picking, ratooning, and especially on pests. The pests causing the most serious damage in Southern Rhodesia are American bollworm, Red or Sudan bollworm, and Stainers.

[*Cf.* Abstr. **27**, Vol. XI., of this Review.]

23. ANGLO-EGYPTIAN SUDAN: *Cotton Production.* By P. K. Norris. (*U.S. Dpt. of Agr., For. Agr. Serv. F.S. No.* 62, 1934.) A very interesting account from an American point of view, dealing with (1) General Conditions in the Sudan: Area and Location, Population, Climate, Agriculture, and Commerce. (2) Cotton Production in the Sudan: The Gezira, Nile Valley, Tokar and Kassala Districts, and the Rain-grown Cotton Districts.

24. *Report of the Gezira Agricultural Research Service,* 1933. The second report contains, in addition to the introductory note by the Controller, reports on the experimental work carried out during the 1932-33 season by the Agricultural, Plant Observation, Plant Physiology, Chemical, Entomological, Botanical, Plant Pathology, and Plant Breeding Sections. Reports on the Plant Breeding extension work at the Gezira Research Farm, and the Field Experiments carried out by the staff of the Sudan Plantations Syndicate, are also included.

From the note of the Controller we learn that the cotton crop made satisfactory and apparently normal growth until mid-October, when a general falling-off occurred, except in the North. The final average yield came out at 1·9 kantars per feddan—less than half that obtained the previous season. Leaf curl and white fly were responsible for a considerable loss of crop, but other factors also contributed, and these are still under investigation. Pending the solution of the fundamental problem of yield fluctuation, very considerable advances have been made by selection and breeding in evolving strains highly resistant to leaf curl disease, and capable of withstanding to a marked degree the conditions which make it impossible to grow Sakel successfully in an unfavourable season. One of

these strains, "X.1530," has been multiplied, and is so far proving very satisfactory. Certain other strains also show promise—viz., "X.04729," "X.730," "X.1730," and "Lecrem."

The importance of close spacing for late-sown cotton was indicated by the "Four Factor Experiments" in 1929-30 and 1930-31, and the value of this has been shown in an even more striking manner by the "Spacing and Thinning Experiment" at the Gezira Research Farm and the "Out-Station Experiments."

In connection with the study of cotton diseases, the results of the repetition of the "Jebel Dud" experiment indicate that the risk of seed transmission of leaf curl is practically negligible. It is asserted that the main carryover of the disease from one season to another is due to infected ratoons. With a view to removing the old cotton plants bodily from the soil, a tool has been designed which carries out this work very satisfactorily, and a modification of the tool is being employed on the whole Gezira area.

Experimental work on the disinfection of cotton seed with various dusts shows that practically complete protection from blackarm for the germinating seedling can be obtained in this way. All seed for sowing in the Gezira was treated with "Abavit B" in the 1932-33 season, and the absence of any observed primary infection proved the efficacy of the treatment.

In areas outside the Gezira Scheme satisfactory progress has been made towards the production of high yielding types of American cotton, with good quality lint, suitable for growth both in the Southern Sudan under natural rainfall, and on the various pump schemes situated on the banks of the Nile in the Northern Provinces.

25. *Impressions on Cotton Growing in the Nile Valley.* By F. Bey Abaza. (*Int. Cott. Bull.*, xii., **48**, 1934, p. 508.) An interesting account of a visit paid to the Gezira in January and February of this year, dealing briefly with irrigation projects, varieties of cotton grown, and the difficulty of controlling pests and diseases.

26. Sudan Plantations Syndicate: *Cotton Cultivation,* 1932-33. (*Rpt. on Admin. Finan. and Condition of the Sudan in* 1933; recently received.) A bumper crop was harvested at Zeidab, an average yield of 5·18 kantars of American cotton to the feddan being obtained, compared with 4·18 the previous season. The new methods of cultivation employed on the Government pumping stations met with immediate success, the average yield on all stations over a total area of 2,537 feddans being 3·15 kantars per feddan, as compared with an average of 1·27 kantars the previous year over an area of 2,600 feddans.

27. Tanganyika: *Cotton Cultivation,* 1933. (*Ann. Rpt. of Dpt. of Agr.,* **1933.**) During the period under review action was taken to prevent the mixing of seed by movement of seed cotton from district to district; to curtail the excessive transport of seed cotton within and without the district in which it was grown; to give the established ginner a greater responsibility for the promotion of the crop in his zone, or (where zoning was not applied) in his district; to secure adequate amounts of good cotton seed free of charge, and its transport to distributing points at the expense of the ginner; to safeguard growers against excessive ginning charges; to reduce the amount of tax taken as cotton cess; and by means of a fair price scale and supervision and check weighing, to protect the native grower against unfairly low returns, and to rectify the customary disparity in values between Nos. 1, 2, and 3 native cotton, and between No. 1 native high grade and bulk crop cotton grown by non-natives and the larger native growers. No new ginneries were licensed, but old ginneries could be re-sited.

The export of cotton lint in 1933 constituted a record for the Territory, being equivalent to 28,419 bales. Actual production was 28,490 bales, as compared

with 18,039 bales in 1932, an increase of nearly 60 per cent., which is particularly satisfactory in view of adverse climatic conditions.

A scheme to reorganize the marketing of cotton was approved by the Cotton Advisory Board. Buying posts were abolished, and in areas of high production were replaced by Ginners' Markets, which gave the ginners equal rights to purchase the crop. One of the most satisfactory features of the marketing was the application to all centres of a minimum price graph prepared by the Director of Agriculture; this has stimulated production in backward areas.

Selection work with U.4 cottons from Barberton and Gatooma and with the local cotton was continued at Morogoro, with a view to evolving a strain suitable for the coastal belt.

Insect pests caused little injury during the year. Pink bollworm incidence was low in the coastal belt, due probably to early maturing of the bulk of the crop. Staining, however, remained high.

28. East African Research Station, Amani. (*6th Ann. Rpt.*, 1933-34.) Contains the usual reports of the Director, Plant Pathologist, Entomologist, Soil Chemist, Biochemist. Plant Physiologist, Plant Geneticist, Systematic Botanist, Superintendent of Plantations, Secretary and Librarian. The Director states that work has proceeded steadily and without interruption. In February a Conference—one of a series convened at the instance of the East African Governors' Conference for the co-ordination of research—was held, and many interesting subjects came up for discussion. During the year the Coffee Experiment Station at Lyamungu commenced to function, and arrangements were made for the establishment of a sisal experiment station. The isolation greenhouses for the Central Plant Quarantine Station were completed.

29. Uganda: *Cotton Cultivation*, 1933-34. (*Ann. Rpt. Dpt. of Agr.*, 1933, Pt. I.; recently received.) The area planted to cotton was 1,090,502 acres. Weather conditions were abnormal in most areas at the beginning of the year, but improved markedly later, and a good yield of cotton was expected. An increased area was planted to S.G.29 cotton. The number of ginneries licensed to gin and bale cotton was 134, as compared with 122 in the previous year. Energetic measures were under consideration to control pink bollworm, which at the end of the year had spread to various districts in the Northern and Buganda Provinces. Injury from other pests and diseases was not serious. During the period under review cotton zones were established by Government with a view to reducing the high overhead charges borne in the marketing and ginning of the raw cotton. There was a marked increase in the use of ploughs in the various districts; an increase of 1,633 ploughs in Teso, 433 in Bugwere, and 142 in Lango district being recorded over the previous year. No appreciable damage to crops was caused by locusts, and no special measures to deal with the pest were considered necessary.

30. *Cotton Reports*, 1933-34. (*Ann. Rpt. Dpt. of Agr.*, 1933, Pt. II.) The Senior Botanist states that definite progress has been made in the improvement of U.4 derivatives at Serere. One or two of the later generations grown there are giving lint very nearly equal to that of S.G.29. As in previous years U.4 has done badly under Buganda conditions, both in yield and in quality. In Buganda S.G.23/8 still remains the most promising strain on account of its very distinct superiority over Local in spinning. Several new types in the Pedigree Lines proved superior to Local as regards yield, quality, and habit. Strains resistant to blackarm have been isolated both at Bukalasa and Serere. These are not altogether satisfactory from other points of view, and crossing with other strains is being undertaken. The appearance of Fusarium wilt in Buganda necessitates work on wilt resistance. A very useful elaboration of the purity target system of testing

for purity of strains has been worked out, and is proving of great assistance. The question of a seed farm for Buganda is under consideration.

In the Entomologist's report it is stated that work on cotton pests was mainly concerned with measures to control the spread of pink bollworm. Other pests encountered were *Lygus*, *Helopeltis*, and stainers, but they caused little damage.

From the report of the Mycologist we learn that research work on blackarm and angular leafspot diseases was continued. Early sowing, and disinfection of seed prior to planting by means of fungicidal dusts, are suggested measures of control. The experiments indicated that both diseases spread much more rapidly on S.G.29, the present standard variety at Serere, than on S.P.1, a selection from U.4/4/2.

31. *Crop Prospects*, 1934-35. The latest report from the Department of Agriculture states that, in spite of the difficult planting season occasioned by long spells of dry conditions in most areas, the total acreage planted to the end of September amounted to 1,080,265 acres, as compared with a total of 1,090,502 in the previous season. The dry conditions have also been favourable to the increase in the numbers of certain sucking insects, particularly *Lygus*, which is causing considerable damage in some areas.

32. *Cotton Industry*. (*Crown Colonist*, October, 1934, p. 475.) "Crop prospects for the 1935 crop are satisfactory. Recent experiments at Government stations show that it is possible to obtain 1,800 lb. seed cotton per acre, yet the average obtained by the grower is only 350/400 lb. per acre. This is due to the carelessness, and in some cases ignorance, of the growers. The Agricultural Department are endeavouring to prove to the native that with a little care and intelligence his yield can be trebled and a better quality of cotton produced, but an intensive campaign is required. . . . Last season's crop was worth to the growers just under £2,000,000, while for the 1933 crop a little over £1,500,000 was paid to growers."

33. AUSTRALASIA. QUEENSLAND: *Factors Relating to the Production of the Harder-Bodied Cottons*. By W. G. Wells. (*Queensland Agr. J.*, xlii., **3**, 1934, p. 371.) Describes the types of cotton required by Australian spinners, and the most suitable soils in Queensland for their profitable production.

34. *Cotton Varietal Testing*. By W. G. Wells. (*Queensland Agr. J.*, xlii., **3**, 1934, p. 364.) This is a very clear account of the way in which an amateur in the work of comparison of varieties can arrive at satisfactory results. The use of the Latin square is considered first, and it is shown how different the result may be from that of merely trying one block of each variety. The Randomized Block system and the Student method are also discussed. Planters who are engaged in testing different varieties of cotton should find this paper of much use.

35. WEST INDIES. SEA ISLAND COTTON. (*W. Ind. Comm. Circ.*, 30/8/34.) From a review of the trading during the 1933-34 season, by Messrs. Molyneux, Taylor and Co., of Liverpool, we learn that there was an improved enquiry, which, however, was rather spasmodic, and old stocks have been considerably reduced. The new crop of Montserrat showed considerable improvement in grade and staple, and was rapidly absorbed at from 14d. to 15d. per lb. Antigua cotton also showed marked improvement, but spinners' reports on St. Kitts cotton indicate a larger percentage of wasty cotton in the bales. Prices generally were higher than for the previous season, averaging 14d. to 16d. for the better qualities.

36. BARBADOS: *Cotton Cultivation*, 1933-34. (*Agr. J. of Dpt. of Sci. and Agr., Barbados*, Vol. III., No. 2, 1934.) "The year was a poor one for cotton, only a very small acreage being planted. The decreasing yield of the last three seasons is not entirely due to bad weather. The law requires cotton-growers to record the acreage planted, but owing to the very low prices many growers, especially peasants,

did not trouble to pick their cotton, and this failure lowered the yield per acre of the cotton that was harvested very considerably. The recent cotton conferences in Barbados and Trinidad, and the general feeling that there is some future before the Sea Island cotton industry, however, will undoubtedly result in increased acreages being planted in the next few years."

Pink bollworm was observed earlier than usual, but caused only slight damage.

To secure the introduction of only healthy material into the island, the holds of fifteen ships were fumigated with Zyklon B, and 12,708 bags of imported seed were disinfected by means of the Simon's Heater.

37. CARRIACOU: *Marie Galante Cotton.* (*Trop. Agr.*, October, 1934, p. 270.) The broker's report on the new hybrid Marie Galante cotton selection, which was received in June, was generally very encouraging as regards the colour and the length, strength, quality, and character of the staple. The value was estimated at around 9½d. per lb., or about 1d. more than Sakel. Two lots, each of 5 lb., of seed of the new Carriacou selection C.1.14 were forwarded at the end of June for trial in Anguilla and Tortola.

38. GRENADA: *Cotton Cultivation*, 1933. (*Ann. Rpt. of Agr. Dpt., Grenada*, 1933.) The results of bulk sample analysis of Carriacou perennial strains 1932-33 are given. Strains giving a mean maximum lint length of 47 mm. were selected for the 1933-34 season. Brokers' reports on samples of Carriacou cottons are good; all are 130-250 points on American July Futures.

39. MONTSERRAT: *Cotton Cultivation*, 1933. (*Rpt. on Agr. Dpt.*, 1933.) A very favourable season was experienced, and record yields of excellent quality lint were obtained. The cotton market improved considerably in the latter half of the year, and the local brokers apparently effected sales of all previous stocks, as well as the lint produced during 1933, at an average price of 12d. per lb. At the prevailing prices estate owners found it impossible to grow cotton by employing their own labour, and much of the estate land was let out to peasants on the half-share system. To maintain the purity of Montserrat cotton a considerable amount of breeding and propagation work is undertaken annually by the Department, and the work has proceeded quite satisfactorily. No serious damage from insect pests or diseases occurred during the year.

40. *Sea Island Cotton Industry*, 1934. (*Trop. Agr.*, October, 1934, p. 268.) The crop suffered considerably from the extended dry season, but showed signs of fairly general recovery at the end of July. Pink bollworm was negligible, but a fair amount of injury was caused by green bug.

41. ST. KITTS, NEVIS, AND ANGUILLA: *Cotton Cultivation*, 1933-34. (*Ann. Rpt. of Agr. Dpt.*, 1933.) A much reduced acreage was planted to cotton in St. Kitts in 1933. Cotton leaf worm was not apparent, but severe damage was caused by pink bollworm. Cotton selection work was carried out on the usual lines. In Nevis there was a revival of interest in cotton cultivation. Germination of the crop was good, but excessive rains interfered with weeding operations in some places, and many of the plants were stunted; the greater part of the crop, however, did fairly well. No damage was caused by cotton leaf worm and very little by pink bollworm; cotton stainers, however, were very plentiful in certain parts. Purchasing of the peasants' cotton was undertaken by the Government on the same lines as in the past. An advance at the rate of 3 cents per lb. was paid for clean Sea Island cotton delivered at the cotton house. The lint was shipped to the British Cotton Growing Association, and was sold at a price which allowed a bonus of 3·25 cents per lb. to the peasants. An increased cotton crop was harvested in Anguilla. The quality of the lint showed improvement, due to the use of hand-picked seed for planting. Experiments carried out with Moco cotton

did not prove successful; boll shedding was very high, and practically no seed cotton was saved.

42. St. Vincent: *Cotton Cultivation*, 1933-34. (*Rpt. on Agr. Dpt.*, 1933.) The area under Sea Island cotton was 1,216 acres and under Marie Galante 719 acres, a total of 1,935 acres, or an increase of 80 per cent. over the previous season. The yield was expected to be low owing to the abnormal weather conditions experienced. Time and again seed was planted only to be washed out by the rains; soils were waterlogged, and the stand of cotton established was poor. Little damage was caused by pests or diseases.

43. *Work of the Cotton Experiment Station*, 1933-34. (*Rpt. on Agr. Dpt.*, 1933.) In connection with the research work on cotton the Acting Commissioner of Agriculture states that "the thanks of the Government are again due to the Empire Cotton Growing Corporation for the work undertaken by the Cotton Research Officer in maintaining the high quality of the island's cotton crop."

From the report of the Cotton Research Officer for the period September 1, 1933, to February 28, 1934, we learn that notwithstanding constant rains experienced at growing time, very good yields were obtained. The island's acreage was exclusively planted with the superfine strain V.135, which is now practically a pure line. Selfed seed of this strain was multiplied in isolation on Mustique Island to obtain seed for the 1934-35 crop. Damage from pests and diseases during the season was insignificant.

Experimental Work. The experiment to transfer the gene R_2 (Red Plant-Body-weak spot) from the Trinidad Red Kidney Tree cotton to Sea Island V.135 was continued. The effect of the gene R_2 on lint length was studied, no significant difference being found in lint length between red and green plants. Selection work with Moco, Carriacou, and Marie Galante cottons was also continued. First crosses were made of Moco and Carriacou cottons with a view to evolving a strain combining the desirable characters of both. The F_2 of Moco × Marie Galante gave some excellent plants, and eleven were retained for progeny rows the following year. In experiments with U.4 cottons containing the Asiatic red gene, samples of which were received from Trinidad and grown in St. Vincent, several plants exhibited remarkable features not previously seen in New World cottons, and doubtless derived from Asiatic. Generally speaking, they were early maturing and very heavy yielders; all were immune from angular spot, and some plants possessed lint lengths of about 45 mm. An experiment on crossing Sea Island with Ishan cotton from Nigeria was continued. Many of the plants were longer linted than Ishan, but nearly all were affected by angular spot.

44. *Cotton Prospects*, 1934-35. A note on the cotton crop for the quarter ended September 30, received from the Superintendent of Agriculture, states that the area under Sea Island is estimated at 1,200-1,400 acres. Weather conditions during September were favourable, and the young plants were progressing very satisfactorily.

COTTON IN EGYPT.

45. Egyptian Cotton: *Cotton Mixing Law.* (*Cotton*, M/c, 20/10/34.) In connection with the Cotton Mixing Law, which came into operation on August 6, 1934, the following Order of the Ministry of Agriculture, Egypt, was published in "Official Journal," No. 79, of September 13, 1934, and came into force on that date:

Art. 1. Each bale of cotton which has been pressed hydraulically or by steam must be marked in Arabic and in a foreign language with the name of the variety of the cotton which it contains. Hydraulically pressed bales must also bear the name of the ginning factory.

Art. 2. Each bale containing mixed cotton must be marked with the word "mixed." Each bale containing cotton which is not included in the annexe to Law No. 51 of 1934 must be marked "not catalogued."

Art. 3. The indications mentioned in Arts. 1 and 2 must be printed in indelible red ink, on at least two sides of the bale, with stamps made specially for this purpose, immediately after the pressing operations, and in the presence and under the control of the delegate of the Ministry of Agriculture.

Art. 4. Any special mark which spinning or pressing factories or a merchant desire to add must be made as far away as possible from the mark laid down in Arts. 1 and 2, and must be in ink of a different colour.

46. PROPOSED MODIFICATION OF ALEXANDRIA CONTRACTS FOR SAKEL AND UPPERS. (*Int. Cott. Bull.*, xii., **48**, 1934, p. 514.) A movement is on foot in Alexandria to modify the contracts for Sakel and Uppers, basing them on the Fully Good Fair to Good classification, instead of Fully Good Fair, their former basis. The reason for this change is stated to be that, at the present time, barely 20 per cent. of the crop comes under the category of Fully Good Fair.

COTTON IN THE UNITED STATES.

47. AMERICAN COTTON: GOVERNMENT CONTROL POLICY. By H. Campion. (*Manchester School*, v., 1934, p. 32. Abstr. from *Summ. of Curr. Lit.*, xiv., **19**, 1934, p. 525.) A history of American cotton policy from the first attempt at stabilisation in 1929. Some lessons from the failure of the stabilisation experiment are pointed out.

48. AMERICAN COTTON: IMPROVEMENT OF GRADE. (*Int. Cott. Bull.*, xii., **48**, 1934, p. 456.) According to Mr. F. L. Gerdes, Cotton Technologist of the Delta Ginning Experimental Station at Stoneville, Mississippi, the quality of lint from seed cotton of a high moisture content can be improved from one to two grades by carefully conditioning the seed cotton before passing it through the gin. The quality of the ginned lint, moreover, can be affected by the rate of feed during the ginning to the extent of one-half to a full grade. The use of a vertical dryer developed by the engineers of the Bureau of Agricultural Engineering is recommended as "one of the most practical and economical means of moisture removal for the present-day farm organization." Results obtained with this dryer are stated to compare favourably with those of sun-drying or storing.

49. PROGRESS IN THE IMPROVEMENT OF AMERICAN COTTON. By N. A. Olsen. (*Cotton*, M/c., 20/10/34.) Summarizes the results of the grade and staple reporting work, the ginning studies, and investigations regarding false packed bales, carried out during the past six years.

50. COTTON: IMPROVEMENT OF QUALITY. (*Text. Res.*, **4**, 1934, pp. 479 and 489. Abstr. from *Summ. of Curr. Lit.*, xiv., **18**, 1934, p. 458.) The American Textile Foundation propose to devote part of their funds to the improvement of cotton quality. So far only some 5 per cent. of the seed at present planted in America comes from seed breeders, the remainder being mongrelized gin-run stocks. The importance of the use of pure high quality seed is indicated.

51. AMERICAN COTTON MARKET: EFFECT OF GOVERNMENT RESTRICTION POLICY. By G. Keiser. (*Wirtschaftsdienst*, xix., 1934, p. 1122. Abstr. from *Summ. of Curr. Lit.*, xiv., **18**, 1934, p. 459.) The effect of the Roosevelt policy of crop restriction on the general cotton market is not as great as might be expected, chiefly owing to doubt as to the powers of the American market to affect prices. Nevertheless, the output of American cotton exceeds that of all other countries com-

bined, so that opposition to American plans is ineffective. Consequently a gradual rise in cotton prices may be expected. Statistics are analyzed.

52. AMERICAN COTTON: PRICE ESTIMATE FOR 1935. By W. H. Slater. (*Text. Weekly*, xiii., 1934, p. 531. Abstr. from *Summ. of Curr. Lit.*, xiv., **16**, **1934**, p. 425.) The author gives a table forecasting American cotton prices for 1935 based on various sizes of American cotton crops and all other known factors at present available. Whilst American conditions and intensive propaganda favour a rise in price, yet the increasing production of outside growths (particularly Brazilian) may frustrate the plan.

53. GRADE AND STAPLE LENGTH OF COTTON CARRIED OVER IN THE UNITED STATES AS RELATED TO THE DOMESTIC SUPPLY, 1928-29 TO 1931-32. By W. B. Lanham and O. T. Weaver. (*U.S. Dpt. Agr. Stat. Bull. No.* 45, 1934.) An examination of the extent to which certain grades and staple lengths are carried over, as compared with other grades and staple lengths, and of changes from year to year in the proportion supplied of particular grades and staples.

54. WORLD TEXTILES, WITH A REVIEW OF AMERICAN COTTON. (Pubd. by *Man. Guar. Coml.*, October 6, 1934.) Contains, among others, the following interesting articles: "American Cotton in 1933-34: Growers Hold the Whip-Hand" (G. W. Fooshe); "Providence and Politics" (G. W. Revere); "Developments in Machinery" (F. Nasmith).

55. OUR NATIONAL COTTON POLICY. By W. L. Clayton. (*Int. Cott. Bull.*, xii., **48**, 1934, p. 444.) An interesting paper, pointing out how America, by her present manœuvres, is losing cotton area to her rivals. The author expects a reduction in American acreage of 8,439,000, and an increase in outside acreage of 8,450,000. The situation is parallel to that which Brazil created by valorizing coffee (*cf.* **170**).

56. AMERICAN COTTON: FUMIGATION IN BENGAL. By M. F. Gandhi. (*Ind. Text. J.*, **44**, 1934, p. 349. Abstr. from *Summ. of Curr. Lit.*, xiv., **18**, 1934, p. 458.) Owing to the increased number of cotton mills in Bengal, some 50,000 bales of American cotton may be expected to be delivered annually at the port of Calcutta. It is suggested that fumigation facilities might be provided there in order to save the expense of fumigation at Bombay, but it is questioned whether the risk of the introduction of live boll weevils is a serious menace to Bengal.

57. GEORGIA: *Cotton Experiments*, 1933-34. (*Ann. Rpt. of Exp. Sta., Ga.*, 1933-34.) In various experiments carried out at the Station, Delta Pine Land 8 and Stoneville No. 2 were outstanding in germinating power and the ability to produce a good stand. Stoneville No. 2 also proved very successful in "one-variety" centres, which are spreading rapidly in Georgia.

In studies on cotton nutrition, evidence was obtained supporting Eaton's conclusion that the cotton plant has a very high boron requirement. About 10 parts per million boron in the culture solution were found to produce the maximum fruit yield where nitrates were used as the source of nitrogen; vegetable growth, however, was slightly depressed.

Various manurial experiments were carried out during the season, the results of which are given, and in addition a study of the production and marketing of the various grades and staple lengths of cotton was continued in co-operation with the Division of Cotton Marketing of the U.S. Department of Agriculture.

58. MISSISSIPPI: *Grade, Staple, and Variety of Mississippi Cotton: Crops of* 1928-32. By L. E. Long. (*Miss. Sta. Bull.* 300, 1933. Abstr. from *Exp. Sta. Rec.*, 71, **2**, 1934, p. 268.) Tables, charts, and maps show (1) the average ginnings in the State, 1928-32, by counties; (2) the number of bales of different staple lengths ginned in the United States and Mississippi each year from 1928-32

inclusive; and (3) by counties, for each year from 1928-32 inclusive, the production of Middling White and better cotton, and different staple lengths and varieties of cotton.

59. NEW MEXICO: *Cotton Breeding Investigations*, 1928-32. By G. N. Stroman. (*New Mexico Sta. Bull.* 217, 1934, p. 39. Abstr. from *Exp. Sta. Rec.*, 71, 3, 1934, p. 315.) The progress of breeding work with Acala cotton is detailed. Quality of lint, particularly as to uniformity of length, was of prime importance in this breeding work. Originally uniformity was measured by the range in length of lint within the progeny, but in 1932 the sorter method was adopted. The convolutions or natural twist of fibre and size of fibres were studied in 1931. The seedling vigour test, begun in 1932 because of a need for better seedling stands of cotton, was used with some success. Family No. 504 of the 1931 progeny test was outstanding in length and uniformity, while in 1932 the progenies from No. 504 were outstanding in length of lint as to the range within progenies, and with respect to the sorter method of testing for length of fibres.

60. SOUTH CAROLINA: *Field Crop Experiments.* By H. P. Cooper *et al.* (*S. Car. Sta. Rpt.*, 1933. Abstr. from *Exp. Sta. Rec.*, 71, 1, 1934, p. 36.) Cotton research embraced the following: Effects of origin and age of seed on germination and seedling growth, seed treatments, cold resistance of seedlings of varieties and strains, fertilizer placement, time of planting tests, and study of length and structure of fibres especially as affected by soil moisture conditions.

61. TENNESSEE: *Select Varieties of Cotton.* By S. H. Essary. (*Tenn. Sta. Circ.* 47, 1934. Abstr. from *Exp. Sta. Rec.*, 71, 2, 1934, p. 185.) In cotton varietal trials from 1928-32 in East, Middle, and West Tennessee, Stoneville No. 2, D. and P.L.4-8, and Acala 44 are indicated for general planting in the State, Cleveland 884 for warmer districts, and Trice where earliness is of prime importance.

COTTON IN FOREIGN COUNTRIES.

62. BRAZIL: SEED SELECTION STATION OF UBERLANDIA. (*Int. Rev. Agr.*, xxv., 6, Rome, 1934, T284.) This Station is situated in the eastern part of Minas Geraes at an altitude of 650 metres; it is directed by the Service of Textile Plants of the Ministry of Agriculture, and subsidized by the Federal Government and by the State of Minas Geraes. The main activities of the Station consist in the intensive cultivation of cotton, varietal trials, and phenological observations on cotton, and the acclimatization of other textile plants, such as jute, etc. Demonstration fields have been established, and selected seed is distributed to the growers of the district. A monthly bulletin is published in which the principal results are summarized.

63. CHINESE TEXTILE INDUSTRY: EXPANSION. (*Spinn. u. Web.*, 52, 27, 1934, p. 14. Abstr. from *Summ. of Curr. Lit.*, xiv., 15, 1934, p. 400.) The textile industry in China has developed considerably during the last sixteen years. European and Japanese firms have erected mills in China, and Chinese concerns have also been established. Cotton cultivation is increasing in the province of Kiangsu, and there are 35 ginneries. There are also 84 cotton spinning mills in China producing chiefly 10, 12, 14 and 20's yarns. The larger concerns spin up to 60's, American and Egyptian cottons being used for higher counts than 32's. There are 231 weaving mills in Kiangsu, in addition to weaving departments run by some of the spinning companies. The large concerns run 1000-1476 looms. Silk, rayon, and woollen mills have been established, and hand-woven products of the old home industries still find a market. There is a small sewing cotton industry. About 221 modern plants for bleaching, dyeing, finishing, and printing are now in operation.

64. Congo: Rapports du Conseil d'Administration et du Collège des Commissaires, Compagnie Cotonnière Congolaise, 1933. (Pubd. Bruxelles, 1934.) A record of very good progress. The chief drawback at the moment appears to be the high cost of transport to Europe.

65. Étude Comparative des Législations Cotonnières en Afrique Equatoriale. By E. Van Geem. (Imprimerie Puvrez, Bruxelles, 1934; price 1s. per copy, post free.) An enquiry into the cotton legislation of tropical Africa, which is of two types: the regime of the cotton zone in the non-British Colonies, and that of free competition in the British Colonies.

Congo began with free competition, but soon adopted the plan of a zone around each ginning factory, with a view to keeping up quality. The factory alone buys, and may buy all the cotton produced in its zone, but the grower may sell in another zone if he prefer. Criticism is made that this system bears heavily on the actual grower, but the price is fixed by the Government. The native gets less than in Uganda, but transport is more costly, the staple is shorter, and the seed cannot be profitably exported. The steady price offered by the Government led to a sense of security among the growers, who were less subject to changes of prices than those in British Africa.

Comparing the figures for Congo with those of Uganda and Tanganyika, the author points out that they show less variability from year to year. The Government was never forced to buy cotton in the absence of regular buyers.

The causes of the success of Uganda are analyzed. Dense population, comparatively good roads, railway to the sea, propaganda by Government aided by the native chiefs, are put down as the main causes. Congo, on the other hand, has thin population, few roads, and vast distances to traverse. The excess of ginneries in Uganda, and their competition, is considered, together with the report of the Commission of Enquiry. The conclusion is drawn that the result of free competition in buying and ginning is bad, and that the recent alterations are in the direction of the Congo system. The latter system also, perhaps, needs modification, though the zone system must in general be adhered to.

The author discusses the question of the remuneration of the grower. He deals largely with the report of Mr. Kemp, the Trade Commissioner, who proposes to establish constants of trade and of remuneration to the growers—maintaining at a certain (modifiable) level their power of purchase, and escaping the present liability to great fluctuations—and points out how satisfactory to all concerned such a result might be. The pamphlet should be of interest to those concerned with cotton in tropical Africa.

66. The Textile Industry in France. (*Econ. Condns. in France* [Cahill]. From *Text. Wkly.*, xiii., 1934, pp. 604 and 651.) I. A General Survey. II. The Cotton Industry.

67. Essais Cotonniers au Maroc: Culture; Étude Technologique. By F. Heim de Balsac and E. Miége. (*Coton et Cult. Cotonn.*, Vol. VIII., p. 147; Vol. IX., p. 9, 1934.) French cotton imports for the last seven years have averaged 1,356,000 bales, though 1932 and 1933 have shown a decrease, especially the former. Of this supply only 77,000 bales (average) come from French Colonies, and almost none from Morocco, where only about 150 hectares of cotton are now cultivated, and where the maximum was 1,000 in 1926. Ratooning, in spite of its disadvantages, is considered to be useful as bringing the cotton to early maturity, a point of great local importance in the Moroccan climate. Irrigation is imperative. A considerable area in Morocco is deemed suitable to cultivation with irrigation, and the usual breeding of local varieties, manuring, and other operations are discussed.

68. THE TEXTILE INDUSTRY IN GERMANY. (*Econ. Condns. in Germany* [Thelwall]. From *Text. Weekly*, xiii., **337**, 1934, p. 629.) A general survey.

69. JAPANESE TEXTILE INDUSTRY: RECENT PROGRESS. (*Text. Weekly*, xiii., 1934, p. 556. Abstr. from *Summ. of Curr. Lit.*, xiv., **16**, 1934, p. 425.) Financial and trading results for the Japanese textile industry for 1931-2-3 are shown. Despite the rise in the price of imported raw materials, the Japanese cotton industry is operating at a very high standard of efficiency. Prices have risen, but the increase in the gross earnings during 1933 and the net profits remaining to the companies show that the industry has prospered since 1931.

70. JAPANESE COTTON INDUSTRY: DEVELOPMENT. By C. Lion. (*Bull. Soc. Ind. de Rouen*, **62**, 1934, p. 226. Abstr. from *J. Text. Inst.*, xxv., **10**, 1934, A515.) The author gives a short account of social organization in Japan, and describes the rapid increase in the Japanese cotton export industry, and the counter measures taken by other countries. He urges similar legislation in the case of France.

71. UNA FABRICA DONDE VIVEN Y TRABAJAN MIL SEISCIENTAS MUCHACHAS. By J. Sauerwein. (*El Sol*, Madrid, 17/7/34.) The author visited a factory of the Dai Nippon Cotton Company of Osaka, which has 130 factories and employs 210,000 operatives. The girls work in two nine-hour shifts (with half an hour off), from 5 to 2, and 2 to 11 p.m. They live in modern and well-equipped buildings, provided with baths, infirmaries, dentists, etc., and are fed at a cost of 15 sen a day. Each girl when at work attends to twenty looms. The girls are allowed five hours a day away from the factory; they are taught other things if they wish in the attached school, and they usually leave after some years to get married. It is said that they save money out of their pay.

72. PROYECTO PARA EL ESTABLECIMIENTO DE LA REGLAMENTACION DEL CULTIVO DEL ALGODON EN EL VALLE DE SANTA. By J. Paez and J. Lamas. (*Bull. No.* 5, Min. de Fomento Direc. de Agr. y Ganaderia, Lima, 1934.) Deals with cotton cultivation in the Valley of Santa, Peru.

73. RUSSIA: LIST OF PUBLICATIONS OF THE INSTITUTE OF PLANT INDUSTRY FOR THE YEAR 1932. By K. F. Margolina. (*Bibliographical Contribution No.* 3, Inst. of Plant Industry, Leningrad, 1933.)

74. COTTON: CULTIVATION IN TURKESTAN. By R. Bey. (*Osteuropa*, ix., 1934, p. 525. Abstr. from *Summ. of Curr. Lit.*, xiv., **19**, 1934, p. 494.) The area planted in Turkestan increased from 53,600 to 785,000 hectares from 1913-16, decreased, owing to political conditions and increased cereal cultivation, to 70,000 hectares in 1922, and has been increased by the Soviet Government to 1,540,000 hectares in 1930, when 10,134 tons were exported out of a total output of 335,800 tons. The area under cotton in the individual republics is indicated, and such questions as water supply and means of transport are discussed.

SOILS AND MANURES.

75. SOIL ANALYSIS: A HANDBOOK OF PHYSICAL AND CHEMICAL METHODS. By C. Harold Wright. (Thos. Murby and Co., London; D. Van Nostrand Co. Inc., New York, 1934; price 12s. 6d. Reviewed in *Bull. of Imp. Inst.*, xxxii., **2**, 1934, p. 337.) The methods described are grouped under Physical Methods, General Chemical Methods, and Special Chemical Methods. Working details are given, as well as references to the original literature.

76. A SIMPLE APPARATUS FOR MEASURING THE COMPACTNESS OF SOIL IN THE FIELD, AND SOME RESULTS OBTAINED IN A CULTIVATION EXPERIMENT. By O. V. S. Heath. (*Emp. Jour. of Exp. Agr.*, ii., **7**, 1934, p. 205.) The construction and method of use of an apparatus for measuring the compactness of soil in the

field are described. It has the advantages of low cost and ease of construction, and is thought to be sufficiently accurate in relation to the errors introduced by soil heterogeneity. Some results obtained with this apparatus on a cultivation experiment are discussed. Statistically significant differences between treatments were found, even with measurements in only three positions per plot.

77. The Use of the Glass Electrode in Soil Reaction and Oxidation-Reduction Potential Measurements. By S. G. Heintze. (*J. of Agr. Sci.*, xxiv., **1**, 1934.)

78. A New Apparatus for Measuring Soil Shrinkage. By A. N. Puri *et al.* (*Soil Sci.*, 37, **1**, 1934, p. 59. Abstr. from *Exp. Sta. Rec.*, 70, **6**, 1934, p. 748.) A description of the apparatus and the method of working.

79. Influence of Soil Acidity upon the Decomposition of Organic Matter in Soils. By J. W. White *et al.* (*Soil Sci.*, 37, **1**, 1934, p. 1. Abstr. in *Exp. Sta. Rec.*, 70, **6**, 1934, p. 749.)

80. Contribution to our Knowledge of the Chemical Nature and Origin of Humus. III. The Base-Exchange Capacity of "Synthesized Humus" (Ligno-Protein) and of "Natural Humus" Complexes. IV. Fixation of Proteins by Lignins and Formation of Complexes Resistant to Microbial Decomposition. By S. A. Waksman and K. R. N. Iyer. (*Soil Sci.*, xxxvi., **1**, 1933. Abstr. in *Exp. Sta. Rec.*, 70, **4**, 1934, p. 450.)

81. The Distillation Method for Determining the Combined Water and Organic Matter in Soils. By G. J. Bouyoucos. (*Soil Sci.*, xxxvi., **6**, 1933, p. 471. Abstr. from *Exp. Sta. Rec.*, 70, **5**, 1934, p. 581.) Further work on the author's distillation method for the determination of combined water and organic matter in soils is reported. The original apparatus and technique have been modified and improved. Data indicating the accuracy of the procedure in determining the water distilled over are presented, and it is shown that "the method also appears to be accurate in determining the organic matter content in soils. The only uncertain factor in the determination of the organic matter is whether the water yielded by the organic matter upon destructive distillation is combined water . . . as in the inorganic soil material." Evidence to show that the water in the organic matter can be considered combined water, as in the inorganic soil material, is adduced.

[*Cf.* Abstr. **72**, Vol. XI., of this Review.]

82. A Migration Method for the Determination of Replaceable Bases in Soils. By L. C. Wheeting. (*Soil Sci.*, 37, **4**, 1934, p. 243. Abstr. from *Exp. Sta. Rec.*, 71, **2**, 1934, p. 155.) A contribution from the Washington Experiment Station describes a new electrical method, and reports upon its experimental results as compared with those of barium chloride and ammonium acetate replacement methods.

83. A Critical Examination of Analytical Methods used in the Determination of Exchangeable Potassium and Sodium of Soils. By M. L. M. Salgado. (*Soil Sci.*, 37, **1**, 1934. Abstr. in *Exp. Sta. Rec.*, 70, **6**, 1934, p. 742.)

84. An Examination of the Degtjareff Method for Determining Soil Organic Matter, and a Proposed Modification of the Chromic Acid Titration Method. By A. Walkley and J. Armstrong Black. (Reprinted from *Soil Sci.*, xxxvii., **1**, 1934.) The chromic acid-hydrogen peroxide method of Degtjareff for the rapid determination of soil carbon is shown to give entirely fictitious results.

85. THE DETERMINATION OF EXCHANGEABLE BASES IN SOILS. (*Tech. Commn. No.* 30, Imp. Bur. of Soil Sci., Rothamsted, 1934.) Pt. I.: A. Methods of Determining Exchangeable Bases in the Absence of Soluble Salts; B. Methods for Soils containing Soluble Salts. Pt. II. Determination of Lime Requirement and Exchangeable Hydrogen. Pt. III. Determination of Exchangeable Bases by Electrodialysis.

86. THE FERTILIZING VALUE AND NITRIFIABILITY OF HUMIC MATERIALS PREPARED FROM COAL. By E. M. Crowther and W. E. Brenchley. (Reprinted from *J. of Agr. Sci.*, xxiv., **1**, 1934.) In all tests the effects of ammonium humate could not be distinguished from those of ammonium sulphate of equal ammonium content. The nitrification tests and the pot cultures afforded some evidence of a slow production of nitrate or available nitrogen from the humic acid. In the field experiments, as in the pots, there was no clear evidence of any fertilizer value apart from that due to the ammonium present.

87. DETERMINATION OF NITROGEN IN SOILS.—IV. By A. Srinivasan. (*Ind. J. of Agr. Sci.*, iv., **3**, 1934, p. 546.) Discusses pre-treatment with oxidizing agents, and its influence on the progress of acid digestion.

[*Cf.* Abstrs. **244**, Vol. X., **77** and **566**, Vol. XI., of this Review.]

88. THE EFFECT OF TIME AND RATE OF APPLICATION OF NITRATE OF SODA ON THE YIELD OF COTTON. By E. B. Reynolds *et al.* (*Texas Sta. Bull.* 490, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **3**, 1934, p. 314.) The effect of the time and rate of application of sodium nitrate on the yield, length, and percentage of lint, size of boll, shedding, and other characters of cotton was studied with Mebane cotton on Kirvin fine sandy loam soil at Troup, and with Acala cotton on Ruston and Orangeburg fine sandy loams at Nacogdoches, from 1927-30. The sodium nitrate was applied at rates of 100, 150, 200, 250, and 300 lb. per acre in combination with suitable amounts of superphosphate and potassium chloride, and applications of sodium nitrate before planting were compared with side dressings applied when the cotton was thinned to stand.

The 200-lb. application of sodium nitrate appeared adequate for cotton at Troup, and 100 lb. gave best results at Nacogdoches. These quantities of sodium nitrate with the superphosphate and potassium chloride are roughly equivalent to 400 lb. of 8-12-4 and 4-12-4 fertilizer, respectively. The side dressings of sodium nitrate at Nacogdoches resulted in an average yield of 203 lb. of lint per acre, or 13·4 per cent. more than where all nitrogen was applied before planting, but at Troup applications before planting produced slightly larger yields of cotton. These differences in yield seemed due to subsoil differences, the Ruston and Orangeburg soils having open friable clay subsoils, and the Kirvin soil a less permeable subsoil. Sodium nitrate, mixtures of sodium nitrate and cotton-seed meal, and ammonium sulphate, compared as nitrogen sources, produced practically the same cotton yields at Nacogdoches, although ammonium sulphate was the best nitrogen source at Troup.

All of the fertilizers used resulted in increased yield, size of boll, number of bolls per plant, percentage of 5-lock bolls, size of plant, number of fruiting branches, and earliness, but they did not increase the length or percentage of lint or reduce the amount of shedding.

89. INVESTIGATIONS OF THE MANURIAL EFFECTIVENESS OF AMMONIUM PHOSPHATE. By A. H. Lewis and K. J. Sinclair. (*Emp. Jour. of Exp. Agr.*, ii., **6**, 1934, p. 154.) A discussion of the theoretical advantages and disadvantages of ammonium phosphates, and a survey of the literature dealing with results of experiments in which the effects of ammonium phosphates on growth and yield are compared with those of equivalent low-analysis mixtures.

90. The Fertilizer Value of Basic Slags and Other Phosphates. By E. M. Crowther and R. G. Warren. (Reprinted from *Agr. Progress*, xi., **1934**.)

91. Fertilizer Mixtures with and without Ground Limestone for Cotton. By J. T. Williamson. (*Amer. Fert.*, iii., **80**, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **1**, 1934, p. 38.) The efficiency of a 6-10-4 fertilizer consisting of ammonium sulphate, superphosphate, and potassium chloride, with and without about enough calcium carbonate as marble dust or dolomite to correct the acidity caused by the ammonium sulphate, was compared by the Alabama Experiment Station in co-operation with farmers. Marble dust was about as effective in the average of 112 experiments as dolomite, which averaged only 13 lb. more seed cotton. Dolomite broadcast in 1932 at a rate sufficient to neutralize the acidity from the annual application of ammonium sulphate for five years, gave during the first two years almost the same results, except on Clarkesville soils, as dolomite applied annually as part of the fertilizer mixture. In these experiments it has been a good practice to add enough lime to the fertilizer to neutralize the acid from the acid-forming materials in the mixture. The limestone added in no case seemed to cause either a loss of ammonia or a decrease in the availability of the superphosphate sufficient to reduce the yields. Except on one soil group, there were yield increases of 40 lb. or more seed cotton per acre where ground limestone was mixed with the fertilizer.

92. Run-Off and Erosion from Plots of Different Lengths. By F. L. Duley and F. G. Ackerman. (*J. Agr. Res.*, 48, **6**, 1934, p. 505.) Soil erosion and surface run-off were measured at the Kansas Agricultural Experiment Station on plots 10, 20, 40, and 100 feet in length, to determine the effect of slope length on these processes. Measurements were made on two such sets of plots.

The soil was a silty clay loam, free from vegetation and loose organic matter, and was surface-cultivated. The first set of plots had a slope of 4 per cent., and the second a slope of 4·4 per cent. To simulate rainfall most of the water was applied with sprinkling cans; in a few cases natural rainfall was used.

There was a larger percentage of surface run-off from the short plots than from the long ones. This seemed to be true with both the heavy and light applications of water for the plot lengths under consideration.

The results for soil erosion were less consistent. When the rate of water application was light, there was a tendency for the erosion from the short plots to run relatively high as compared with the others. When the rate of application was heavy—*i.e.*, 1 inch in fifteen minutes—erosion was greater on the long plots. These results indicate that when rainfall is light, short plots may possibly undergo the greater erosion, but when rains are heavy the reverse is true.

93. Soil Erosion: Control of Coastal Cultivation and Grazing Lands. By E. S. Clayton and J. L. Green. (*Agr. Gaz. of New South Wales*, xlv., **7**, **1934**, p. 361.) Stresses the advantages of contour furrows.

94. Further Aspects of the Soil Erosion Problem. By E. DuToit. (*Farming in S. Afr.*, ix., **10**, 1934, p. 295.) The evils of sheet erosion in South Africa are discussed. The best method of control suggested is the growth of a dense grass cover; where this is not possible the contour-bank system appears to be the soundest method to employ.

[*Cf.* Abstr. **571**, Vol. XI., of this Review.]

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

95. A Note on the Value of Correlation and Regression in Statistical Analysis. By D. D. Paterson. (*Trop. Agriculture*, xi., **7**, **1934**, pp. **160** and **290**.)

A continuation of a previous paper which was intended as an elementary guide to the agricultural student. The author writes as follows: "Recent enquiries have shown that the scope of the previous article could be extended with profit, and are responsible for the present attempt to widen the field of information. As in the previous article, all explanations have been worded as simply as possible, and the subject has been treated strictly from the practical viewpoint. Mathematical proofs have been omitted, and descriptions are limited to the application of accepted theorems to experimental results. The examples cited are intended merely to illustrate the progressive stages in the analytical methods detailed in the text. In order to make the calculations easy to follow, the data have been confined, as far as possible, to simple integers, and the number of variables recorded has been cut down considerably below the point in experimental work at which statistical treatment is merited. The examples must not be regarded as at all representative of the material which the statistician normally has to work with, and they are not meant to illustrate the type of records required for accurate analysis of any of the problems exemplified."

[*Cf.* Abstr. **88** of Vol. XI of this Review.]

96. COTTON SEEDS: EFFECT OF DISINFECTION ON GERMINATING POWER. (*Coton et Cult. Cotonn.*, viii., 1933, p. 167. Abstr. from *Summ. of Curr. Lit.*, xiv., **19**, 1934, p. 509.) The results of tests of the effect of treatment with hot water, sulphuric acid, and carbon disulphide on the germinating power of cotton seeds are tabulated and briefly discussed. Treatment with water at temperatures between 60° and 80° C. produced a definite reduction in germinating power. Comparatively long periods of treatment at lower temperatures may have a greater effect than treatment for short periods at higher temperatures. When treated with sulphuric acid the seeds suffer a loss in weight, due not only to the removal of lint but also to attack of the outer coating. When the germination tests are started on the day following the acid treatment a decrease in the percentage germinating is observed in comparison with untreated seeds, but if a period of fifteen days be allowed to elapse between the acid treatment and the tests, the germinating power of the treated seeds only differs slightly from that of the untreated seeds. Acid treatment causes an acceleration of germination which is particularly noticeable when the tests are carried out soon after the treatment. Treatment of cotton seeds with carbon disulphide for forty-eight hours, using 1 kg. per cubic metre, produced a marked lowering of germinating power.

97. INFLUENCE DE L'ÉCIMAGE ET DES PINCEMENTS, COMBINÉS AVEC FUMURES DIFFÉRENTES, SUR LES CARACTÉRISTIQUES TECHNOLOGIQUES DES FIBRES DE COTON. By F. Heim de Balsac and E. Miege. (*Coton et Cult. Cotonn.*, ix., **1**, 1934, p. 1.) Topping, and pinching off of secondaries seem to exercise no influence on the technological characters of the cotton fibre. The only noteworthy effects of fertilizers are that nitrates appear to injure the length and regularity of the fibre, whereas other nitrogenous fertilizers promote ripening and thickening of the walls.

98. FRUITING CHARACTERS AND TIME AND COST OF PICKING COTTON VARIETIES. By G. A. Hale. (*J. Amer. Soc. Agr.*, i., **26**, 1934, p. 38. Abstr. from *Exp. Sta. Rec.*, 71, **2**, 1934, p. 186.) Harvesting studies, made during the period 1930-32 on sixteen varieties tested for yield in the regular cotton varietal experiment at the Georgia Experiment Station, demonstrated that the group of varieties with short lint and high lint percentages had a shorter picking time and a lower harvesting cost per bale of lint than the group with long lint and low lint percentages. Large-boll varieties with a small number of bolls per bale of lint required a very much shorter time to pick the seed cotton, and a significantly lower harvesting cost per bale of lint, than the medium- and small-boll varieties with many bolls per bale.

The number of bolls picked per hour for the sixteen varieties was correlated negatively with the number of pounds of seed cotton picked per hour, and with the cost of picking the lint. The time required to pick a bale of lint was correlated highly and positively with the time required to pick 100 lb. of seed cotton, and the cost of picking the lint was correlated highly and positively with the time required to pick the seed cotton on an hour basis, but not on a seed cotton basis.

99. SOME EXPERIMENTS WITH LEGUMINOUS CROPS AT IBADAN, SOUTHERN NIGERIA, 1925-33. By O. T. Faulkner. (*Emp. Jour. of Exp. Agr.*, ii., **6**, 1934, p. 94.) Describes an extensive series of experiments carried out during the years 1925-33 at Ibadan, Southern Nigeria, in green-manuring and into the effect of leguminous crops on later crops. The primary object of the experiments was to study whether it is possible, by the inclusion of a sufficient number of leguminous crops in a rotation, to maintain land constantly at a high level of fertility. The results are summarized by the author as follows: "We find that at Ibadan a green-manure crop need only occupy the land long enough to make a heavy growth; that burning is not only the most convenient, but also the best method of disposing of the crop, as judged by the effect on the yield of a succeeding crop; that complete removal of the parts of the green-manure crop above ground reduces, but is far from wholly preventing, the benefit that results in the crop that follows a leguminous one. On the other hand, whatever be the method of disposal of the green-manure crop, comparatively little benefit remains after one exhaustive crop has succeeded it. It must again be emphasized that it is not suggested that these conclusions will hold good where the conditions are dissimilar to those at Ibadan. It is believed that they may hold good elsewhere in the tropics wherever the land is light and the rainfall heavy and prolonged; but it is strongly suspected that, in several respects, almost exactly opposite conclusions would result from similar work in a dry sub-tropical climate. There is no means of judging whether these results have any significance in connection with green-manuring in temperate climates."

100. L'HUILE DE COTON. By E. Andre. (*Coton et Cult. Cotonn.*, Vol. IX., 1934. p. 21.) A general description of the oil, its production and utilization.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

101. INSECT PHYSIOLOGY. By V. B. Wigglesworth. (Methuen and Co., Ltd., London, 1934; price 3s. 6d. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **10**, 1934, p. 540.) In this general account of the physiology of insects, based on original work and on a study of nearly 2,000 publications (of which only the more recent ones have been included in the bibliography), the author has endeavoured to meet the demand for increased knowledge on this subject on the part of the economic entomologist. Descriptions are given of the major functions of the organs and tissues, and the mechanisms by which they are co-ordinated to serve the purpose of the insect as a whole, various points being illustrated by reference to particular genera or species. Separate chapters deal with the integument, respiration, and circulatory system, and the blood, digestion, excretion, nutrition, and metabolism, reproduction and growth, and the nervous system, sense organs, and behaviour.

102. LES INSECTES NUISIBLES AU COTONNIER EN AFRIQUE EQUATORIALE FRANÇAISE. By L. Monteil. (*Agron. colon.*, No. 193, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **5**, 1934, p. 209.) Notes are given on various insect pests of cotton observed in French Equatorial Africa. Severe injury is caused by *Locusta migratoria migratorioides*, and another Acridid, *Acanthacris ruficornis*, has often been observed severing the young woody shoots. In some fields 5 per cent. of the

seedlings and newly-thinned plants have been destroyed by *Brachytrypes membranaceus*; one individual may cut through ten seedlings or four to five young plants bearing flower buds. Mining larvæ of Buprestids, probably *Sphenoptera* sp., cause considerable damage. The Meloids, *Coryna* (*Mylabris*) *hermanniæ*, F., and *C.* (*Zonabris*) *guineensis*, Mars., are very common, and destroy numbers of cotton flowers. Weevils, such as *Alcides gossypii*, Hust., and *Myllocerus* spp., are abundant in the dry season. *Syragrus calcaratus*, F., and *Lœtana histrio*, Baly., and other leaf-eating beetles are common during the rainy season, but at the beginning of the dry season their numbers diminish. The Tineid, *Acrocercops bifasciata*, is abundant throughout the cotton zones, and causes severe injury to young seedlings. *Earias insulana*, Boisd., is generally distributed, but *E. biplaga*, Wlk., is much less numerous. Little injury has recently been caused by *Heliothis obsoleta*, F., and *Prodenia litura*, F. *Diparopsis castanea*, Hmps., is very abundant on cotton; the damage it causes increases as the season advances, and is most severe when large, almost mature, bolls are attacked. The Pentatomid, *Glypsus conspicuus*, Westw., which is said to prey on bollworms, is abundant in the region investigated, but its predaceous habits have not been confirmed. A Jassid, possibly *Empoasca* (*Chlorita*) *facialis*, Jac., appears when the cotton comes into flower, and is found throughout the season on leaves and young shoots, causing crinkling of the foliage and withering of the extremities. As a potential vector of diseases it deserves further study. The stainer *Dysdercus superstitiosus*, F., is abundant throughout the cotton zone.

Minor pests are: *Margaronia* (*Glyphodes*) *indica*, Saund., *Negeta luminosa*, Wlk., *Zeuzera* (*Azygophlebs*) *boisduvali*, H.-S., *Anoplocnemis curvipes*, F., *Odontopus sexpunctatus*, Lap., *Oxycarenus hyalinipennis*, Costa, and *Aphis gossypii*, Glov.

103. PRODROMO DI ENTOMOLOGIA AGRARIA DELLA SOMALIA ITALIANA. By G. Paoli and A. Chiaromonte. (Istituto Agricolo Coloniale Italiano, Firenze, 1931-33.) A copiously illustrated work containing an account of the pests that are of most agricultural importance in Italian Somaliland, and their parasites. Sixty-seven varieties of insects are recorded as injurious to cotton. Information is also given concerning the climate and agriculture of Italian Somaliland. A bibliography of 104 names is included, together with indexes of the pests and of the plants attacked by them.

104. RELATIONSHIP BETWEEN EARLY VARIETIES OF COTTON AND BOLL WEEVIL INJURY. D. Isely. (*J. Econ. Ent.*, xxvii., **4**, 1934, p. 762.) Early varieties were, as usual, found least liable to weevil injury, but the effects of dusting were more marked upon the late varieties of cotton.

105. FIELD-PLAT TESTS FOR BOLL WEEVIL CONTROL AT TALLULAH, LOUISIANA, DURING 1933. By M. T. Young. (*J. Econ. Ent.*, xxvii., **4**, 1934, p. 749.)

106. THE DEVELOPMENT OF THE BOLL WEEVIL ON PLANTS OTHER THAN COTTON. By R. C. Gaines. (*J. Econ. Ent.*, xxvii., **4**, 1934, p. 745.) Several species of *Hibiscus* were found to serve as host plants.

107. THE INFLUENCE OF SOIL MOISTURE UPON SURVIVAL OF THE PINK BOLLWORM. By A. J. Chapman. (*J. Econ. Ent.*, xxvii., **4**, 1934, p. 820.) This paper records observations on the effect of different more or less constant soil-moisture percentages in sandy-loam and clay-adobe soils on the winter survival of the pink bollworm, and upon the time of emergence of long-cycle moths. The experiments were carried out at Presidion, Texas, during the seasons 1931-32 and 1932-33. The highest survival over the two-year period in the sandy-loam soil occurred at an average of 16·72 per cent. soil moisture, and in the clay-adobe soil at an average of 16·82 per cent. soil moisture. The peak of moth emergence was reached during May from both types of soil, regardless of the soil moisture, provided it was above

5 per cent. The peak of moth emergence in the dry soils of both types was reached in July.

108. Investigations on the Control of the American and Red Bollworms of Cotton in South Africa. By F. S. Parsons and G. C. Ullyett. (Reprint from *Bull. Ent. Res.*, xxv., 3, 1934.) Methods have been devised and applied to an intensive study of the course of bollworm activity on numerous rain-grown and irrigated crops. These were developed in the first instance to enable accumulation of data considered essential for evaluating the usefulness of certain egg and larval parasites when released experimentally, and they have now been extended to the point of providing continuous, quantitative data on boll-wormfood-plant relations. This work has been placed on a routine basis. The information that is supplied comprises:

1. The course of oviposition in point of duration, magnitude, and time of occurrence in the life of a host crop. This serves well to indicate the true course of moth activity on different food-plants, the relative attractiveness of these, and to reveal if such matters are maintained under different conditions and bear definable relations to growth stages of a food-plant.

2. The identity and activity of egg and larval parasites under natural conditions.

3. The identity and activity of insects predatory on the eggs and larvæ, as occurring in the varied insect communities associated with different crops.

4. Comparative mortality of larvæ in the different crops where oviposition has been recorded.

Continuous records of egg-laying by the American bollworm, *Heliothis obsoleta*, F., have been taken at the Cotton Station, Barberton, and on several farms in the neighbourhood. Cotton and maize were the principal crops, but the surveys included a number of other food-plants. Egg-laying was found to be very closely associated with the period of bud and flower production, and its duration on different hosts thus varies according to the flowering habit.

In the case of maize, egg-laying in quantity commences when the tassels (staminate flowers) are extruding, and the peak of the oviposition is passed before silks (pistillate flowers) are abundant. This is at variance with the generally accepted view that the plant is most heavily oviposited upon during the silking period. The typical course of oviposition on maize here lasts for two to three weeks only. Numerous instances were observed where oviposition by *Heliothis* occurred on maize in tassel to the practical exclusion of neighbouring cotton in freely fruiting and healthy condition, and the possibilities of exploiting this relationship are discussed.

As regards winter-irrigated vegetable crops and citrus orchards, data are given showing that the American bollworm breeds extensively in these crops, particularly so a month or two prior to the appearance of rain-grown cotton, maize, and tobacco. The irrigated crops in the Barberton and contiguous districts are regarded as a main source from whence bollworm on cotton is derived. Citrus orchards, of which there are relatively large acreages, may be of particular importance in this regard.

The methods of obtaining information on the course of moth emergence are described. Data are given that explain the course of moth activity in winter crops, and indicate when moths enter rain crops from winter-breeding areas.

The only larval parasite of importance under natural conditions is *Sturmia inconspicua*, but this fly does not parasitize young larvæ. There is a scarcity of insects parasitic on American bollworm larvæ, and the question of importing them should be considered. Breeding and experimental releases of a larval parasite, *Microbracon brevicornis*, are discussed. Two important egg parasites are a species of *Phanurus* and *Trichogramma lutea*.

An Anthocorid bug, *Orius* sp., destroys large numbers of bollworm eggs and probably also young larvæ, and this insect and certain species of ants are the most important agents in natural control.

As regards the red bollworm, *Diparopsis castanea*, Hmps., it is concluded that the use of trap crops should be discouraged for general adoption as a means of controlling it, owing to the danger, through inattention to the trap crops, of breeding this bollworm in them. Its incidence in former years is briefly reviewed. Of late years the annual infestation has diminished greatly in some districts, but not in others. The variations in this regard are attributed mainly to the presence, or otherwise, of ratooned cotton, particularly in mild winters, and to seasons of very late planting.

109. NOTES ON SOME INSECT PESTS IN THE LESSER ANTILLES. By H. A. Ballou. (*Trop. Agr.*, xi., **8**, 1934, p. 210.) The Cotton Worm, *Alabama argillacea*, is a major pest of cotton in the West Indian cotton-growing islands. Its most important natural enemy, especially in St. Vincent, is the Jack Spaniard wasp (*Polistes* spp.). *Polistes* attacks the larvæ of *Alabama argillacea*, but is itself rendered very scarce in some islands by the attacks of the larvæ of the moth *Calceola* (*Dicymolomia*) *pegasalis*.

110. LA CHENILLE DU COTONNIER (*Alabama argillacea* HÜBNER) EN HAITI. By A. Audant. (*Congr. Int. Ent. Paris*, 1932. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **4**, 1934, p. 190.) *Alabama argillacea*, Hb., causes serious injury to cotton in Haiti, where whole plantations are frequently defoliated by the larvæ in early summer. In a rainy region the plants may put out several successive series of leaves, to be each in turn destroyed by fresh generations of larvæ, of which there may be as many as six, and still produce a crop at the end of five to six months, although the bolls will be poor and small. In dry regions, however, the plants are so much weakened by the first attack that they entirely fail to produce a crop. The larvæ feed for about two weeks, causing most damage in the last few days, and then pupate in rolled leaves, and possibly also in the soil. After four to five days the adult moth appears, and pairing and oviposition follow immediately. The total life-cycle lasts about twenty days. When the dry season begins in November the larvæ disappear, and the eggs are almost all destroyed by parasites. It has been suggested that the moths, which are very strong fliers, migrate to some part of America where growing cotton offers more favourable conditions, or that larvæ hatching from a few eggs laid in December survive and maintain the annual cycle. More probably some larvæ enter the soil about December and pass the period January-April there in the pupal stage, the adults emerging after the heavy rains in April or early May.

Calcium arsenate and lime, either as a dust (1: 10) or as a spray (1: 2-3 lb. in 50 U.S. gallons water) may be applied, if necessary, when the plants come into flower. Earlier in the season it is better to let the larvæ continue to feed, as a certain reduction of the leaf surface may even be beneficial. During this period parasites, such as *Trichogramma minutum*, Riley, and *Brachymeria* (*Chalcis*) *incerta*, Cress., reduce the numbers of the host considerably. The pupæ may be destroyed by hand in small fields. Clean cultivation and thorough pruning of the plants after harvest are strongly recommended, particularly in rainy regions.

111. LIFE-HISTORY AND CONTROL MEASURES OF THE COTTON GEOMETRID (*Baormia* sp.). By F. Li. (In Chinese, with English summary.) (*Tech. Bull. Bur. Ent. Chekiang, No.* 13, Hangchow, 1933. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **8**, 1934, p. 444.) In 1919, *Baormia* sp. caused serious injury to cotton over an area of about 67 sq. miles in a coastal district of Kiangsu. In 1931 this Geometrid had five generations in the field, the larvæ pupating in the soil. The females from over-

wintered pupæ had an oviposition period of 1-5 days and the others of 2½-5½ days, the number of eggs laid averaging 1,109 and 220 respectively. Control measures recommended are: deep ploughing between November and April; intensive cultivation during the cotton-growing season; crop rotation with wheat and rice for two or three years; protection of beneficial animals, especially frogs; and the use of light traps before the oviposition periods.

112. THE LIFE-HISTORY AND CONTROL MEASURES OF THE COTTON LEAF-ROLLER, *Sylepta derogata*, F. By F. Li. (In Chinese with English summary.) (*Tech. Bull. Bur. Ent. Chekiang, No.* 12, Hangchow, 1933. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **8**, 1934, p. 444.) Investigations were undertaken in Nantung in 1930 and in Shanghai in 1931. It was found that one female may lay over 200 eggs. Four generations probably developed in 1931, the egg stage lasting three days, the larval twenty-two, and the pupal eight days. The mature larvæ of the last generation over-winter. Nine species of Hymenopterous parasites were obtained from this Pyralid, eight from the larvæ and one from the pupæ. Up to 55 per cent. of the larvæ were attacked by one Chalcid, which had a life-cycle of about twenty days or more at Nantung. An average of eleven individuals of this Chalcid develop in a single host.

Measures recommended for control are: Early planting of cotton; clean cultivation; the use of light traps for the moths; the application of sprays against the larvæ of 2 lb. Paris green, 3 lb. lime, and 150 gallons water, or 2 lb. lead arsenate, 6 lb. soap, and 25 gallons water; and the protection and encouragement of parasites.

113. THE PRESENT POSITION OF THE COTTON STEM WEEVIL PROBLEM. By K. Dharmarajulu *et al.* (*Madras Agr. J.*, xxii., **6**, 1934, p. 204. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **9**, 1934, p. 517.) Since it was first noticed in Coimbatore on Cambodia cotton, *Pempheres affinis*, Fst. (cotton stem weevil) has spread to almost every cotton area in the Madras Presidency, and to all varieties of cotton. The weevil oviposits in a cavity made by preference on the hypocotyl regions of the cotton plant, and covers the egg with a gummy secretion. The young larva cuts through the medullary ray and tunnels round the stem along the cambium, taking a slanting, downward course and feeding on the soft portions. It then scoops out a pupal chamber in the wood, the adult emerging by cutting the bark at the other end. The plant often succumbs in consequence to mechanical disturbances, such as high winds. Two Chalcidoids have been observed parasitizing the larvæ. Field trials with earthing the plants up to the cotyledonary node, thus covering the non-hairy parts and leaving above ground only the hairy ones, gave some promise of control. Experiments are also being made to produce a Cambodia variety with a hairy hypocotyl. Close spacing appeared promising. As adults, pupæ and larvæ soon died when the plants were dried immediately, sun-drying would prevent emergence from the stalks. In the authors' experiments, the weevil only bred on cotton, and occasionally on *Corchorus* (jute). By shortening the growing period of cotton so as to enable two early harvests to be gathered, a long close season could be observed that might starve out the weevil.

114. THE RESULTS OF OUR METHOD OF CHECKING THE DUSTING OF COTTON PLANTS INFESTED BY *Epitetranychus althææ* WITH FLOWER OF BRIMSTONE. By M. I. Kosobutskii. (In Russian, with English summary.) (Pubd. Tashkent, 1931. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **8**, 1934, p. 440.) At the best, dusting appeared only to retard the increase of infestation, though the ultimate loss of crop was less than in the untreated fields.

115. LES PARASITES DU CRIQUET MAROCAIN EN AZERBAIJAN. By A. A. Zakhvatkin. (In Russian, with a summary in French.) (*Bull. Plant. Prot.*, Ser. 1, No. 9,

1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, 5, 1934, p. 242.) The parasites of egg-pods of *Dociostaurus maroccanus*, Thnb., observed in Azerbaijan, included the Meloids, *Mylabris zebræa*, Mars., and *M. fusca*, Ol., all stages of which are described in detail, with figures and some observations on their bionomics. A key is given to the triungulins of these species and five others of the same genus that occur in Azerbaijan in the same habitat as the locust, but have not been recorded as parasitic on it there. *Cytherea armeniaca*, Paramonov., is a much less important parasite of the egg-pods, and another Bombyliid, *Anastœchus mylabricida*, sp. n., the adult, larva and pupa of which are described, proved to be a secondary parasite in them, developing on the larvæ of Meloids, particularly *M. zebræa*. Parasitism of the egg-pods by these insects is sometimes as high as 100 per cent., though it averages only 22·4 per cent. A fungus, *Fusarium* sp., which develops in spring, destroys on the average another 24·6 per cent.

116. The Solitary Phase of *Schistocerca gregaria*, Forsk., in North-Eastern Kordofan (Anglo-Egyptian Sudan). By R. C. Maxwell-Darling. (*Bull. Ent. Res.*, xxv., 1, 1934, p. 63. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, 5, 1934, p. 262.) Two years' work in Kordofan has revealed the fact that the phases *dissocians* and *solitaria* of *Schistocerca gregaria*, Forsk., are established there, and have persisted in the absence of invading swarms. . . . Of the three edaphic and climatic areas into which north-eastern Kordofan can be divided, the highest population of solitary locusts was found on the sandy hills (" gozes ") in the southern half of the area. The soils, vegetation, and climate of each area are described in detail. A series of microclimatic observations made in different habitats are recorded, and the behaviour of adult locusts correlated with the daily changes in temperature. Ecological observations on other Acridids are described.

117. The Moroccan Locust (*Dociostaurus maroccanus*, Thunb.) in the Stavropol Province (N. Caucasus). By S. Zhdanov. (In Russian, with English summary.) (*Bull. Plant Prot.*, Ser. 1, No. 9, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, 5, 1934, p. 242.) A study carried out over three years of the ecology of *Dociostaurus maroccanus*, Thnb., in the Stavropol region, North Caucasus, and in particular the vegetative cover and the microclimate of the breeding places.

118. Observations on Phases of the Red-Winged Locust in Northern Rhodesia. By A. P. G. Michelmore and W. Allan. (*Bull. Ent. Res.*, xxv., 1, 1934, p. 101. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, 5, 1934, p. 263.) The observations on which this paper is based were carried out in Northern Rhodesia during the 1932-33 breeding season of *Nomadacris septemfasciata*, Serv., when its swarms invaded the settled areas of the country. Detailed descriptions are given of the egg, the vermiform larva, and the six hopper instars of ph. *gregaria*, and the morphological features serving to distinguish the stages are discussed in detail and illustrated. The colour pattern of ph. *dissocians* is analyzed in comparison with that of ph. *gregaria*. The occurrence of ph. *dissocians* in the field is described with reference to the probable factors causing variation in certain characters. Hoppers of ph. *congregans* were observed in the field, but no characters could be found to distinguish them from those of ph. *dissocians*.

Cage experiments in breeding hoppers under varying degrees of crowding indicated that development of *gregaria* colouring is connected with the activity induced by crowding. Hoppers of an aberrant pallid coloration usually proved to be infested with one or two Nematodes. The effects of parasitism on the colour pattern are in a certain degree comparable with those of the factors responsible for the appearance of the *dissocians* type of coloration, but different parts of the colour pattern do not react to parasitism and to *dissocians* factors in the same way.

The changes in the adult coloration of both ph. *gregaria* and ph. *dissocians* are described. Cage experiments suggest that swarm colouring in the adult is affected by the degree of crowding, but the development of the red and purple coloration of the hind wing in *gregaria* and *dissocians* is affected by different factors, and it is probable that the pigments are not identical. Biometrical data based on a large amount of material established definite measurable characters that may be used to distinguish the two phases.

119. Observations Préliminaires sur la Résistance au Froid de *Schistocerca gregaria*, Forsk. By C. Rungs. (*Rev. Path. veg. Ent. agric.*, **20**, Nos. 9-10, 1933. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **6**, 1934, p. 327.) In experiments with adults of *Schistocerca gregaria*, Forsk., ph. *transiens*, taken in January and February from swarms in Morocco, exposure for not more than ten hours to a temperature as low as − 5° C. (23° F.) did not in any way affect their subsequent behaviour and development. Even after being frozen quite hard, they gradually became normally active, and even able to pair and lay eggs. Exposure for more than ten hours was fatal.

These experiments help to explain observations made in 1932 and 1933 during the passage of swarms across the Atlas Mountains, when locusts encountering a low temperature at a high altitude became inactive and dropped to the ground, but revived next morning as soon as they were warmed by the sun. If the weather continued cold and cloudy, however, they sometimes died. Moreover, if a locust settled on the surface of the snow while its body temperature was still fairly high owing to the flight, it melted the snow round it and slowly sank into it. In the meantime its body temperature became equal to that of the snow, and a crust of ice formed round it and caused its death. Several swarms have been found dead under such conditions. Hoar-frost, on the other hand, cannot produce any lasting effects.

120. Note Préliminaire sur *Schistocerca gregaria*, Forsk., dans le Nord-Ouest du Soudan Français. By B. N. Zolotarevsky and J. de Lepiney. (*Bull. Soc. Hist. Nat. Afr. N.*, xxv., **2**, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser A, **6**, 1934, p. 327.) The conditions of climate and vegetation in most of the localities where solitary locusts were found do not seem to be favourable for a transformation into the gregarious phase, and further investigation is necessary for the discovery of other permanent breeding-places that may be more suitable.

121. Il Grillastro Crociato (*Dociostaurus maroccanus*, Thunb.) e le sue Infestazioni in Sardegna. By A. Melis. (*Atti R. Accad. Georgofili* [**5**], **30**, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **6**, 1934, p. 328.) The history of locust outbreaks in Sardinia is reviewed. The author considers it possible that swarms of *Dociostaurus maroccanus*, Thunb., which is much the most important species, may occasionally migrate to the Island from Africa, and quotes some old records to that effect, but the analysis of several outbreaks shows that permanent breeding areas exist in the northern part of the Island itself, particularly along the upper and the middle courses of the rivers Coghinas and Tirso.

Detailed descriptions are given of all stages in the development of this locust and of *Calliptamus italicus* L., which is also sometimes injurious in Sardinia, and the life-history of the former is described.

122. Révision Sommaire du Comportement de *Schistocerca gregaria* Forsk., ph. *gregaria*, dans les Lieux d'Habitat Temporaire. By J. de Lepiney. (*Congr. Int. Ent. Paris*, 1932. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **4**, **1934**, p. 192.) A summary of recent studies on the behaviour of hoppers of *Schistocerca gregaria*, Forsk. The behaviour of adults while not flying is almost identical with that of hoppers. The direction of flight is not determined by topographic details

or by the position of the sun. The locusts show no apparent reaction to wind, which consequently does not determine the direction of their flight, but merely influences it mechanically. A tendency to fly against the wind occurs only when the locust takes off; during the flight, the air current will always be from front to rear, independently of wind.

123. PARASITOS MAS IMPORTANTES DE LA LANGOSTA *Schistocerca paranensis*, BURM. By J. B. Marchionatto. (*Bol. Mens. Min. Agr. Nac.*, xxxiv., **2-3**, 1933, Buenos Aires. Abstr. from *Rev. App. Mycol.*, xiii., **7**, 1934, p. 439.) Notes are given on the pathogenicity, life-history, and taxonomy of the following parasites of *Schistocerca paranensis* in the Argentine Republic: *Coccobacillus acridiorum* d'Hérelle, *Sporotrichum paranense* n. sp., and *Fusarium* sp. The most conspicuous symptom of infection by *S. paranensis* is the vivid red colour of recently dead insects, which later assume a nacreous-white tinge and become mummified. The internal organs develop a profuse greenish efflorescence consisting of the reproductive bodies of the fungus, and visible through the body wall. A species of *Fusarium* allied to *F. acridiorum* was found covering the eggs with a white, cottony, septate mycelium; the affected eggs eventually acquire a waxy consistency.

124. LOCUST CONTROL. (*Crown Colonist*, June, 1934, p. 250.) In an aeroplane specially chartered and equipped for the purpose Mr. H. H. King is flying across the line of flight of locust swarms in Northern Rhodesia, discharging upon them clouds of finely ground sodium arsenite dust. Mr. King had previously found in laboratory experiments that the adult locust, on being sprayed with this material, speedily succumbed, and he accordingly suggested the present experiment to the Locust Control Committee. With the aid of a grant from the Colonial Development Fund, technical advice and assistance on the many practical problems involved were mobilized from the Royal Aircraft Works at Farnborough, the Imperial Institute of Entomology, and the Chemical Defence Research Department of the War Office. The experiments are expected to cost some £4,000, but this is a small sum when compared with the enormous damage caused by these insects, which one estimate places at £1,500,000 annually. The machine in use is a de Haviland Hercules type supplied by Imperial Airways, fitted with special apparatus for discharging the dust from the wings, the cloud forming behind the machine as it flies. No danger is involved to human beings. It is possible that the trial flight may disclose the necessity for some technical modifications, but if, as is expected, it proves substantially effective, this will be a powerful weapon for combating the scourge, and Colonial planters will be immensely relieved. Nevertheless, it is essential that the international work of research into the breeding grounds and habits of the various species of locusts should continue to be actively prosecuted.

125. NUTRITIVE VALUE OF LOCUSTS. By E. Adler *et al.* (*Farming in S. Afr.*, ix., **99**, 1934, p. 232.) It is stated by the authors that locusts can be used as stock-feed, since locust meal contains a high percentage of protein. The following analysis of Redwing locusts (caught and killed immediately before reaching the flying stage) is given, together with an analysis of peanut and coconut oil-cake, for purposes of comparison:

	Locusts.	*Peanuts.*	*Coconuts.*
Moisture	10·5	6·6	10·0
Ash	5·0	4·8	4·8
Protein	46·1	44·8	21·1
Fat	9·6	10·2	3·0
Fibre	12·5	7·6	11·0

Locust meal can be used for feeding with feeding stuffs such as maize, in order to obtain a balanced ration, and can be substituted for oil-cake meal, which is frequently fed to stock with concentrates. It is palatable to stock, and fodder containing 10 per cent. of it was greatly relished at the Potchefstroom School of Agriculture.

The analysis indicated that owing to the high percentage of fat in locust meal it is unsuitable as a fertilizer.

126. Preliminary Observations on Cotton Stainers and Internal Boll Disease of Cotton in South Africa. By E. O. Pearson. (Reprint from *Bull. Ent. Res.*, xxv., 3, 1934.) Records of stainer infestations in cotton have been taken at the Cotton Experiment Station, Barberton, South Africa, since 1931, and in 1933 a uniform system of recording stainer populations in cotton by sampling 10-acre blocks was extended to four farms in the Barberton district, three farms in Swaziland, and the Cotton Experiment Station at Magut, Natal.

The records so obtained show that stainers normally appear in plant cotton in late February or early March. *D. intermedius*, Dist., is present in comparatively small numbers throughout the season; *D. nigrofasciatus*, Stal., and *D. fasciatus*, Sign., are very variable in relative abundance. In 1933 the latter species was practically absent from cotton at all points save those in the vicinity of ratoon or standover cotton, but in 1931 and 1932 it appeared in numbers equal to those of *D. nigrofasciatus* and bred up a very much larger population in the crop.

Where normal migration occurs, all three species of stainers pass through two and a partial third generation in the crop; at the end of the season part of the adults migrate from the crop, and the remainder, together with the bulk of the nymphs, may be destroyed by appropriate clean-up measures.

Extensive surveys of the Transvaal Low Veld and rapid tours of portions of Swaziland, Zululand, and Portuguese East Africa, indicate that the principal wild food-plants of stainers in these regions comprise the genera *Abutilon*, *Gossypium*, *Hibiscus*, and *Sida* in the Malvaceæ, *Melhania* and *Sterculia* in the Sterculiaceæ, and *Adansonia* in the Bombaceæ. The Baobab occurs in large numbers in the Northern Transvaal, but it has not yet been proved to be a winter food-plant. The latest information shows that during the summer it may commonly be infested with *D. fasciatus*.

In conjunction with stainer population records in the crop, weekly systematic records of damage to the crop have been obtained from samples of bolls which have been examined for puncturing, and graded for degree of staining. The number of punctures per boll and the percentage staining are strongly correlated, but it has proved difficult to correlate these with stainer population, except where young bolls are examined.

Internal boll disease, particularly early in the season, may be due to bacterial organisms transmitted by species of Hemiptera other than stainers. Later in the season the infection of the crop is more definitely due to *Nematospora* spp., of which *N. gossypii* is commoner than *N. coryli*.

All species of stainers collected on cotton have been found to transmit *Nematospora*, though they are not efficient vectors until the fourth instar is reached. Adult stainers collected on wild food-plants (*Gossypium herbaceum* var. *africanum*, *Hibiscus* spp., and *Sterculia rogersii*) have been shown to be infected with *N. gossypii*.

The etiology of the disease produced by both species of *Nematospora* has been followed in inoculation experiments, using pure cultures. The rate of spread of the disease varies with the age of the boll at the time of inoculation, being slower when the boll has passed middle age. In neither species does staining extend

beyond the loculus in which infection starts, nor does the fungus occur within the seed except following direct puncturing of the seed.

The fact that the staining is not co-extensive with the region occupied by the fungus, but goes far beyond it, and that a pathological condition indistinguishable from that due to the living organism may be produced by injecting a sterilized suspension of the fungus, suggests that the death of the lint hairs, producing staining, is due to a toxic substance liberated by the developing fungus.

127. A PRELIMINARY STUDY OF THRIPS ON SEEDLING COTTON, WITH SPECIAL REFERENCE TO THE POPULATION, MIGRATION, AND INJURY. By J. C. Gaines. (*J. Econ. Ent.*, xxvii., **4**, 1934, p. 740.) Deals briefly with investigations carried out in an upland and a bottom land cotton field in the vicinity of College Station, Texas. *Frankliniella tritici* (Fitch) and *Sericothrips variabilis* (Beach) were the two most common species found, while *Frankliniella fusca* (Hinds) was also observed in small numbers.

128. SOME COMMON SPECIES OF THE GENUS THRIPS (THYSANOPTERA). By E. R. Speyer. (*Ann. App. Biol.*, xxi., **1**, 1934, p. 120. Abstr. from *Exp. Sta. Rec.*, 71, **2**, 1934, p. 220.) The author here calls attention to the economic importance of the Thysanoptera as an order, and the necessity for a revision of the classification. The range of variation, within the species, of characters which have in the past been used for the separation of species in the genus *Thrips*, is illustrated. A general account of the biology and a more detailed account of that relating to some common species are given.

129. TANGANYIKA: BARRIER TO TSETSE. (*Crown Colonist*, November, 1934, p. 514.) Several thousand natives are working to clear a belt 100 miles long and 2 miles broad to defend their lands against the invasion of tsetse fly. It is tribal labour turned out by native authority to combat the peril, which is threatening the Singida highlands at two southern points. These danger places will be protected by the great belt of cleared forest now being cut, since tsetse will not cross shadeless land. Each native works on the clearing for ten days, when he is free until next year. Fresh batches of 3,000 natives arrive every ten days at two distant sections of the clearing. These sections will meet in eight years' time, when the scheme reaches fruition.

130. CONTRIBUTIONS TO A KNOWLEDGE OF THE WHITE FLIES (ALEURODIDÆ) OF EGYPT—II. By R. Priesner and M. Hosny. (*Tech. and Sci. Serv. Bull. No.* 139, Min. of Agr., Egypt, 1934.) Four species are discussed, but none has yet been observed on cotton.

131. INSECTS AND A MITE OF POTENTIAL ECONOMIC IMPORTANCE FOUND ON WILD COTTON IN FLORIDA. By C. F. Rainwater. (*J. Econ. Ent.*, xxvii., **4**, 1934, p. 756.) The following five insects are discussed in the order of their importance as found on wild cotton in Florida: Wild Cotton Borer (*Rhodoneura terminalis* Walker), Flower-bud Maggot (*Contarinia gossypii* Felt.), West Indian Blister Mite (*Eriophyes gossypii* Banks), Cotton Leaf Miner (*Nepticula gossypii* Forbes and Leonard), and *Anomis impasta* Guenee.

132. BIOLOGICAL NOTES ON SOME DIPTERA IN SOUTHERN RHODESIA. By A. Cuthbertson. (*Proc. Rhod. Sci. Ass.*, xxxiii., 1934, p. 32. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **10**, 1934, p. 555.) The species dealt with include *Stomatorrhina lunata*, F., of which the larvæ were present in Southern Rhodesia at the time of oviposition of the red locust (*Nomadacris septemfasciata*) during November-December, 1933.

The Tachinids recorded from Lepidopterous hosts include the following: *Dejeania bombylans*, F., a common and widely distributed species that was

abundant in Salisbury during September and March-April, from the American bollworm (*Heliothis obsoleta*, F.).

133. PHYTOPATHOLOGICAL AND BOTANICAL RESEARCH METHODS. By T. E. Rawlins. (John Wiley and Sons, New York; Chapman and Hall, London, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **4**, 1934, p. 454.) The manual is in three parts, of which the first deals with the choosing and planning of a research project. The second part, experimental methods, takes up certain of the methods of botanical microtechnique and microscopy, together with culture methods, virus studies, and miscellaneous experimental methods; and part 3 discusses the interpretation of experimental results. A classified bibliography of 960 entries is appended, together with a subject index.

134. THE PLANT DISEASE INFLUENCE IN COLONIAL DEVELOPMENT. By J. C. F. Hopkins. (*Rhod. Sci. Asscn. Proceedings and Transactions*, xxxiii., 1933-34.) A lecture with an historical flavour, pointing out the serious effects exercised on agricultural progress and its location by great outbreaks of disease or pest, and emphasizing the importance to Rhodesia of careful study.

135. SOME ASPECTS OF THE PLANT VIRUS PROBLEM. By K. M. Smith. (*Agr. Progr.*, xi., 1934, p. 88. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **10**, 1934, p. 541.) The history of plant virus diseases is briefly reviewed, and the physical properties of the viruses (reactions to physical and chemical agents, length of life in extracted sap, filtrability, etc.) are discussed.

136. THE PLANT VIRUS IN THE INSECT VECTOR. By K. Smith. (*Arch. exp. Zellforsch*, **15**, Jena, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **10**, 1934, p. 540.) Insect vectors of plant viruses are classified as purely mechanical, half-specific (where the virus concerned is transmissible only by a particular group of insects), and specific (where it is transmissible only by that particular species). Although no correlation has yet been found between any physical property of a plant virus and its transmissibility by insects, many insect-borne viruses seem to have a high capacity for adsorption to certain substances, and also have a very short life *in vitro*.

137. INSECTS IN RELATION TO VIRUS DISEASES OF PLANTS. By K. M. Smith. (*Agr. Progr.*, xi., 1934, p. 86. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **10**, 1934, p. 541.) Examples are given of varying degrees of closeness in the association of plant viruses with insect vectors.

138. EXPERIMENTS BEARING ON THE NATURE OF INTRACELLULAR INCLUSIONS IN PLANT VIRUS DISEASES. By F. M. L. Sheffield. (*Ann. of App. Biology*, xxi., **3**, 1934, p. 430.)

139. FURTHER OBSERVATIONS ON THE NATURAL DISTRIBUTION OF THE COTTON ROOT-ROT FUNGUS. By C. J. King *et al.* (*Phytopath.*, xxiv., **5**, 1934. Abstr. from *Rev. App. Mycol.*, xiii., **10**, 1934, p. 632.) Cotton root-rot (*Phymatotrichum omnivorum*) has recently been recognized in Southern Utah, which may provisionally be considered the northern limit of the fungus, while southward the disease extends into Sonora, Mexico, and Lower California. In 1933 the fungus was found on dying and dead Mexican poppy (*Argemone* sp.) plants a short distance south of the United States—Mexican boundary in a mountain wash draining through the Jacumba (California) settlement, where some lucerne fields were observed to be infested about a year earlier. Under desert conditions the detection of the root-rot fungus is very difficult, being dependent on the casual discovery of a dead plant or of the rise of spore mats to the surface in wet weather. Early infestations in the Gila Valley are often traceable to diseased mesquite (*Prosopis juliflora*) roots or stumps or to the shrub *Lycium*. In addition to the native

species already listed as root-rot carriers, the following were observed to bear the mycelium of the fungus in 1933: *Franseria confertiflora*, *Gutierrezia lucida*, *Platanus wrightii*, *Parkinsonia aculeata*, *Aster spinosus*, and *Cercidium torreyanum* (*P. torreyana*). Evidence is adduced in support of the view that the movement of water in erosion and drainage from the higher elevations may play an important part in the infestation of the cultivated areas of the lowlands and deltas.

[*Cf.* Abstrs. **126** and **596**, Vol. XI., of this Review.]

140. Insects as Possible Distributing Agents of Cotton Root-Rot caused by *Phymatotrichum omnivorum*. By J. J. Taubenhaus and L. D. Christenson. (*Phytopathology*, xxiv., **7**, 1934, p. 839. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **10**, 1934, p. 570.) Experiments in the United States, in which *Blapstinus fuscus*, Csy., *Harpalus* sp., and larvæ of other insects that normally feed on cotton, were fed on plants infected with *Phymatotrichum omnivorum*, showed that they did not spread this fungus.

141. Nutritional Requirements of the Root-Rot Fungus, *Phymatotrichum omnivorum*. By W. N. Ezekiel *et al.* (*Plant Physiol.*, ix., **2**, 1934. Abstr. from *Rev. App. Mycol.*, xiii., **10**, 1934, p. 633.) This is a full account of the authors' studies of the nutritional requirements of *Phymatotrichum omnivorum*. In pure culture the fungus utilized the phosphate, magnesium, potassium, and probably also the sulphate mineral ions. Nitrogen was utilized equally well from organic sources (*e.g.*, amino-acids, peptone, and urea), inorganic ammonium, and nitrate salts. Ammonium nitrate was frequently the best source of nitrogen, a fact which is apparently in contradiction with the results obtained by Neal, Webster, and Gunn, who, however, used ammonium nitrate and other nitrogen sources at concentrations found in these experiments to be too high for optimum growth. As sources of carbon the fungus utilized pentose and hexose monosaccharide sugars, disaccharide sugars, starch, and to a lesser degree mannitol. The best growth was produced in alkaline solutions; good development still occurred at pH 3·7, but growth was inhibited at approximately pH 3. There was no evidence that the fungus produced staling substances in the substrata after thirty-three days' growth.

The addition of small quantities of carrot juice to synthetic media resulted in a disproportionately large increase in growth of the fungus, but both of the vitamins A (from cod-liver oil) and B (from rice bran extract), at the concentrations used, were shown to be of little nutritive value to *P. omnivorum*. Sclerotia developed most abundantly in media best suited to rapid and abundant vegetative growth.

The variety of nutrient conditions found to be suitable for *P. omnivorum* agrees well with its wide host range, and also with the fact previously established that the immunity of monocotyledonous plants is apparently determined by the presence in them of substances toxic to the fungus, rather than by any lack of nutrients.

[*Cf.* Abstr. **640**, Vol. VIII., of this Review.]

142. Parasitic and Other Fusaria Counted in Tropical Soils. By O. A. Reinking and M. M. Manns. (*Ztschr. Wiss. Biol. Abt. F. Ztschr. Parasitenk.*, vi., **1**, 1933. Abstr. from *Exp. Sta. Rec.*, 70, **3**, 1934, p. 344.) Fifteen tropical soils, of which fourteen were distinct soil types, were investigated for the presence of parasitic and other species in the genus *Fusarium*. The relative number and distribution per gramme of soil for these fusaria were determined for each soil type, a variety of meteorological conditions being represented. Twenty-four fusaria, included in eight different *Fusarium* sections, were isolated from the various soil types, the largest number being from the section Elegans, which includes the vascular wilt disease producing organisms. Certain types were commonly found in all soils tested, while other types were found only in certain soils.

143. Insects as Possible Distributing Agents of Cotton Wilt caused by *Fusarium vasinfectum*. By J. J. Taubenhaus and L. D. Christenson. (*Phytopathology*, xxiv., 7, 1934, p. 839. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, 10, 1934, p. 570.) In experiments in the United States, insects that had fed in screened cages on various parts of cotton plants infected with wilt (*Fusarium vasinfectum*) were surface-sterilized, together with some of their fæcal pellets, and cultured on nutrient agar in petri dishes. Good growth of the fungus was recovered from the following insects or their excreta: *Lachnosterna* (*Phyllophaga*) *crassissima*, Blanch., grasshoppers, *Ataxia crypta*, Say, and larvæ of *Anthonomus grandis*, Boh., and *Heliothis obsoleta*, F. None was obtained from wireworms. The fungus was also recovered from all parts of the gorged alimentary canals of hoppers of *Schistocerca americana*, Drury, and larvæ of *Alabama argillacea*, Hb. When, however, insects fed on infected cotton were starved for several days until all the fæcal matter had been eliminated, no fungus was obtained from sections of the alimentary canal. As the fungus recovered in these experiments was capable of infecting normal cotton plants, many insects that feed on cotton may aid the spread of the disease.

144. Variety Tests in the Differentiation of Two Cotton Wilts. By W. N. Ezekiel and J. J. Taubenhaus. (*Phytopath.*, xxiv., 3, 1934. Abstr. from *Rev. App. Mycol.*, xiii., 8, 1934, p. 508). Cotton varieties have been tested in Texas for their reaction to wilt caused by *Fusarium vasinfectum*, and to an apparently different wilt temporarily designated "Waxahachie wilt" from the district in which it was found. The latter disease is marked by a discoloration of the central part of the stems or roots, instead of the darkening of the outer xylem found in *Fusarium* wilt. None of the fungi isolated from cases of the new disease has reproduced it, so that its cause is still obscure. The varieties tested reacted somewhat differently to the two diseases. Thus, both in 1929 and 1930, Rhyne's Cook showed the least infection by *F. vasinfectum*, but was only moderately resistant to Waxahachie wilt. The Watson and Wannamaker-Cleveland selections of Dixie Triumph are both about equally resistant to *Fusarium* wilt, but show considerably greater susceptibility to the Waxahachie form.

145. An Undescribed Sclerotium Fungus Prevalent in North-East Texas. By D. C. Neal and R. E. Wester. (*Phytopath.*, xxiv., 5, 1934. Abstr. from *Rev. App. Mycol.*, xiii., 10, 1934, p. 634.) Latin and English diagnoses are given of *Ozonium texanum* n. sp. found in 1932 on decayed cotton roots, stalks, and leaves just below soil level at Greenville, Texas. The fungus is characterized by a septate, sterile mycelium, at first white, later pale yellow or buff, and hyphæ with opposite or alternate branches arising below the septa and growing in opposite directions or at an angle of 45° to the axis, with individual cells averaging 60 by 5·5 μ in diameter, forming plectenchymatic strands which enlarge into white to pale yellow sclerotia, 1-5 mm. long, of variable shape, usually ellipsoid or radiciform, constricted, often forked at the strand connections, occasionally round or ovoid. The species differs from *Phymatotrichum omnivorum* in the finer texture of the strands, rapid formation of sclerotia on agar, apparent saprophytism, ease of culture, and in the absence of acicular hyphæ and right angle branches.

146. Control of Cotton Wilt and "Rust." By J. O. Ware and V. H. Young. (*Bull. No.* 308, Agr. Exp. Sta., Arkansas, 1934.) Data are presented concerning the various properties of many of the newer Arkansas wilt-resistant strains of cotton, especially the new Arkansas Rowden strains. Many of the promising newer types, such as those developed from Delfos, the tested Stoneville strains, certain strains of Acala, and Qualla, are shown to be highly susceptible to cotton wilt under the conditions of this experiment, and are clearly undesirable when the disease is severe.

Further studies on the relation of fertilizers to the control of cotton wilt indicate that if sufficient amounts of potash, either in the form of muriate of potash or kainit, are used to control "rust," or potash hunger, the incidence of cotton wilt is greatly reduced. When potash is applied alone, however, yields of seed cotton are often markedly inferior to those when the same amount of potash is used in a complete fertilizer. Nitrate of soda and superphosphate alone and in combination are ineffective for the control of cotton wilt and "rust." In some cases such applications resulted in such an unbalanced condition in the cotton plant that it actually increased the amount of damage from "rust" and possibly from cotton wilt.

Stable manure applied at the rate of 10 tons per acre gave yield increases comparable to those secured by the application of 600 lb. of a 6-8-6 fertilizer, and also gave good control of "rust." However, it was only slightly effective in cotton wilt control.

Although further work is needed, indications are that the best programme for the control of cotton wilt and "rust" will result from the use of a suitable wilt-resistant variety, and the application of a mixed fertilizer containing sufficient potash to eliminate "rust" or potash hunger.

[*Cf.* Abstrs. **587**, Vol. V., **630**, Vol. VI., and **603**, Vol. IX., of this Review.]

147. VERTICILLIUM WILT OF COTTON IN GREECE. By L. E. Miles. (*Phytopath.*, xxiv., **5**, 1934. Abstr. from *Rev. App. Mycol.*, xiii., **10**, 1934, p. 632.) Information has been received from J. A. Sarenjanni that the cotton wilt caused by *Verticillium albo-atrum*, previously recorded in the United States, was observed in 1932 in Greece on crops grown from American seed, and has since spread throughout the country. No evidence of the occurrence of the fungus within the cotton seed has been obtained, but it is inferred, though actual proof is lacking, that the disease was introduced with seed from the United States. Cultures of the Greek *Verticillium* received at Mississippi proved to be identical with American isolations.

[*Cf.* Abstr. **444**, Vol. X., of this Review.]

GENERAL BOTANY, BREEDING, ETC.

148. SOME VIEWPOINTS OF AN APPLIED BIOLOGIST. By W. B. Brierley. (Reprint from the *Ann. App. Biol.*, xxi., **3**, 1934.) An interesting address by the retiring President of the Association of Applied Biologists, dealing with such problems as the relationships of scientific disciplines, teaching and research ideals, the cultural value of scientific study, and the nature and validity of science itself.

149. A NEW METHOD OF SELF-POLLINATING COTTON. By W. W. Ballard. (*Circ. No.* 318, U.S. Dpt. of Agr., Washington, D.C., 1934.) Describes a new method of obtaining self-pollinated seed by means of paper cones, which is stated to be quite as effective as the paper-bag method, and permits more than twice as many flowers to be treated in an equal period. Illustrations show the selfing cone in position on the cotton flower, and the method of making the cones.

150. A STUDY OF LINT AND SEED DEVELOPMENT IN COTTON AS INFLUENCED BY ENVIRONMENTAL FACTORS. By D. G. Sturkie. (*J. Amer. Soc. Agron.*, i., **26**, 1934, p. 1. Abstr. from *Exp. Sta. Rec.*, 71, **2**, 1934, p. 184.) The influence of soil type, climatic conditions, and soil moisture on the development of lint and seed in cotton was studied at the Alabama Experiment Station. Plants of Mexican Big Boll were grown on Norfolk sandy loam from Auburn, Alabama, and Deer Creek loam, a deep fertile alluvial soil from Stoneville, Miss., in galvanized iron cans, to study the influence of soil type. Field-grown plants, protected against rainfall and irrigated at different intervals, were used for studying climatic and soil moisture responses. The length of lint, weight of boll, number of seeds, weight

per seed, weight of lint per seed and per unit weight of seed, and percentage of lint, were determined for each boll.

Neither soil type, temperature, humidity, nor evaporation appeared to affect any of the characters studied. The amount of available moisture in the soil affected length of lint markedly, a low moisture content resulting in a short lint. The critical period in elongation of lint was about sixteen days, beginning on the date of blooming. The length of lint could be shortened at least 3 mm. ($\frac{1}{8}$ inch) by reducing the soil moisture to a critical point. A certain minimum and maximum length of lint for this strain of cotton was apparent.

The weights per boll, per seed, of lint per seed, and the lint index were reduced by lack of soil moisture, and the percentage of lint and weight of lint per unit weight of seed were increased by a deficiency in soil moisture, the critical period for these characters extending from one to forty-two days after blooming. Lint percentage varied less with soil moisture changes than did the lint index. The number of seeds per boll did not depend markedly on environmental conditions, yet the number tended to be reduced by extreme drought. A heavy boll was due largely to an increase in the weight per seed and weight of lint per seed. Favourable soil moisture conditions produced heavy bolls with a long lint, heavy seed, large lint index, and low percentage of lint.

151. Cellulose Membranes: Formation. By W. K. Farr and S. H. Eckerson. (*Contributions Boyce Thompson Inst.*, vi., 1934, p. 189. Abstr. from *Summ. of Curr. Lit.*, xiv., **19**, 1934, p. 509.) The limiting membrane of the young cotton hair is continuous with the lateral walls of the epidermal cell from which it originates, and is composed of pectic substance. From the time of the first slight bulging of the outer wall of the epidermal cell there are, in the cytoplasm, particles of uniform size, separate or in beadlike strands, which play an important part in the later development of the cell wall. These particles are ellipsoid, covered with a thin layer of pectic substance. The pectic substance is localized by ruthenium red, and when it is dissolved off with ammonium hydroxide, the cellulose nature of the particles can be shown by their double refraction, parallel extinction, refractive index values, and behaviour in the sulphuric acid-iodine test. It is observed that these particles may exist singly or in chains, that toward the centre of the lumen the single and short chain types of arrangement predominate, that as the wall is approached the chains become longer, and that a single chain of closely compacted particles forms a single fibril of the hair wall. Other examples of the formation of cellulose membranes discussed are provided by *Aspergillus sporangiophores*, *Hibiscus* seed hairs, and *Spirogyra*. Coloured photomicrographs are reproduced.

152. Spinning Quality of Cotton in Relation to Seed Purity and Care of Seed Stocks. By J. H. Moore and R. T. Stutts. (*Tech. Bull. No.* 45, Agr. Exp. Sta., Raleigh, N. Carolina, 1934.) The relation of changes in a standard cotton variety of known origin and quality to care in handling of seed stocks by growers, was studied, and also the influence of changes in fibre properties upon spinning quality.

The lack of significant differences in fibre strength, diameter, and weight indicated that these properties did not influence the yarn strength of the cottons. The combed samples of seed cotton from pure and mixed seed showed considerable differences in variability of staple length, and these differences showed a correlation with yarn strength. In Baer-sorter arrays prepared from composite samples of the ginned cotton, the curves of measurements indicated a change in fibre distribution due to a shifting and decreasing fibre length. The comparisons of fibre length by several methods showed that some of the lots were significantly different in this property. The averages of 20 pulls from ginned cotton were associated with yarn strength. A strong negative association was shown for the relation of

yarn strength and the percentage of fibres ⅞ inch and under. Cotton grown from registered seed made the strongest yarns in all counts. Yarns spun from cottons that had been grown from practically pure seed for periods of two, three, and four years from the Experiment Station showed no significant differences in strength. These yarns as a whole were 4-6½ per cent. weaker than those spun from cotton grown from registered seed. Yarns spun from cottons grown from mixed seed gave the lowest breaking strength; they were 12-13½ per cent. weaker than the same counts spun from registered seed of the same variety. No difficulty was encountered in manufacturing the cottons. Cottons from mixed seed of the strain apparently ran through the machines as well as the cottons from pure seed. The results indicated the value of pure seed stocks in the manufacture of strong yarns, and that precautions taken by growers to keep their planting seed pure were worth while. Maintaining the purity of the seed stocks prevented a marked decrease in the length of staple. Where mixing of seed took place, due to lack of precautions, the proportion of shorter fibre lengths (measured on a mechanical sorter) was increased.

153. A NOTE ON THE DIFFERENTIATION OF HAIRS FROM THE EPIDERMIS OF COTTON SEEDS. By A. N. Gulati. (*Ind. J. of Agr. Sci.*, iv., **3**, 1934, p. 471.) The author replies to criticisms of his earlier conclusions raised by Barritt in this Review, Vol. IX., 1932, p. 126. The results of further photomicrographic studies of the epidermal layer of growing cotton seeds are discussed. The observations bring out three points—viz. (1) Mitotic division of epidermal cells does not cease after the first day of flowering, and is shown to exist in longitudinal sections of seeds up to the tenth day of their development after flowering; (2) hair cells appear to go on sprouting on the growing seed till about the third week; hairs emerging from the epidermis are again shown in close proximity to old ones in sections of seeds up to the tenth day; (3) microtome sectioning of growing cotton seeds is not impossible, as is categorically affirmed by Barritt. The presence of mitotic division in epidermal cells affords definite proof of their multiplication in number with increasing age, and the presence of new hairs near old ones remains suggestive of their continuous differentiation. Photomicrographs illustrating these points are included.

154. CHROMOSOME NUMBER AND MEIOTIC BEHAVIOUR IN *Gossypium*. By J. M. Webber. (*J. Agr. Res.*, 49, **3**, 1934, p. 223.) The reported haploid chromosome numbers of 13 for all Asiatic cottons, for wild American species of *Gossypium*, and for *Gossypium sturtii*, and of 26 for all cultivated American cottons are confirmed. Of species hitherto unreported, *G. darwinii* is found to have 26 haploid chromosomes and *G. kirkii* approximately 24 diploid chromosomes.

Although a few bivalents in cultivated cottons are attached by interstitial chiasmata, the majority are attached by 1 or 2 terminal or subterminal chiasmata. The wild American species and *G. sturtii* apparently exhibit only terminal or subterminal chiasmata. The total number of attachments is relatively high for the small size of the chromosomes.

The wild American species and *G. sturtii* exhibit normal meiotic behaviour.

Occasionally in cultivated American cottons from 1-5 quadrivalents are formed. Disjunction and distribution of partners in quadrivalents is apparently normal. Apparently from 0 to 18 secondarily paired bivalents occur in the species having 26 pairs of chromosomes.

Occasionally in cultivated cottons during first anaphase a few lagging bivalents occur. Generally the partners of such laggers finally disjoin and are distributed to opposite poles, or occasionally are left in the plasma. Rarely disjunction fails, and the lagging bivalents are distributed as a whole to one pole.

Chromosome counts and behaviour during the homotypic division show that

spores of cultivated cottons occasionally have less and rarely more than the characteristic haploid number of chromosomes.

The sporads of the majority of cultivated cottons show more abnormalities than would be expected in the case of a species exhibiting normal meiotic behaviour.

All pollen grains apparently develop normally.

Evidence is presented that the chromosomes within a cotton species are heterogeneous in shape and very nearly equivalent in size.

Evidence is presented that the species having 26 pairs are of tetraploid nature. However, attention is drawn to the fact that the final proof of this tetraploid nature and the consequent phylogenetic interpretations rest upon the type of pairing that occurs in American-Asiatic cotton hybrids.

The possible occurrence of aneuploids in cultivated cottons is discussed.

A list of the literature cited is included.

155. THE GENES OF THE REDUCTION DIVISION. By L. A. Sapehin. (In Russian, with English translation.) (*Bull. of App. Bot. of Gen. and Plant-Breeding*, ii., **5**, Leningrad, 1933.) The various sections are headed: Problems of the Work; Lagging of the Chromosomes and Partial Falling Out of their Conjugation; Formation of Diploid Gametes; The Formation of Septas in Dyads and Tetrads; Entire Absence of Conjugation of the Type "Side by Side"; Formation of Tetravalents; Discussion; The Conjugation of Chromosomes.

156. AMERICAN WILD COTTONS WITH THIRTEEN CHROMOSOMES. By T. H. Kearney. (Reprinted from *J. of Hered.*, xxv., **8**, 1934.) A discussion of these species (*Klotzschianum, Davidsonii, Harknessii, Armourianum*), with a key and useful illustrations. All are lintless. Kearney is of opinion that Thurberia, in which some are placed, has only subgeneric rank.

157. COTTONS WITH THE ZERO TYPE OF BRANCHING AND THEIR PRACTICAL VALUE. By V. I. Kokuev. (Central Asia NIHI, Moscow and Tashkent, 1933. From *Plant Breeding Abstracts*, iv., **4**, 1934, p. 320.) The cluster type of cotton plant in which several bolls are borne on a single internode, as opposed to a long sympodium with several internodes, is of advantage for mechanized harvesting. It also reacts more favourably to dense planting. Although the Egyptian cottons are characterized by long sympodial internodes and the American cottons by short, individuals can be found among the Egyptian cottons with internodes shorter than the average American, and *vice versa*. Observations were made on the form of sympodium in homogeneous lines of a number of varieties representing the different types, and the lengths of the sympodial internodes are tabulated. The types are referred to as O to IV.

As early as 1925 crosses were made between Barraka line 150 of the O (cluster) type and a number of varieties representing the different types according to internode length; in later years the work was extended.

The F_2 generations from crosses with types I and II, grown in 1927, contained individuals of the O type conspicuous both for their high productivity and lint quality as compared with the parental forms, which are shown by tables of the F_2 yields. On these grounds the author refutes Zaitzev's statement that the cottons of this type are useless for practical purposes. In crosses mainly of Barraka 150 and Triumph 35, many O type hybrids have inherited the favourable characteristics of the parents, though others have failed to do so. Already 300 lines of this type have been produced, and some of them are regarded as suitable for commercial utilization. Some develop a "cap" of bolls at the tip in place of the growing point, a character which is transmitted to the offspring, and is of great practical value in that it increases the yield. The O type proved to be recessive in the F_2

generations of the crosses. The only essential for producing commercially valuable hybrids of this type is that the F_2 populations be sufficiently large, in view of the complex nature of the other desirable characters. The cluster character is inherited equally simply in interspecific crosses of American and Egyptian cottons. F_5 hybrids fully constant in this and in agronomic characters have already been obtained from such crosses. They are commercially inferior on account of low quality and yield; however, only 240 F_2 plants were grown, and satisfactory hybrids should be produced by careful choice of parental species and the use of larger populations. Transgression was observed in these crosses for large boll, earliness, short lint, and other characters.

158. MOTES IN COTTON. I. PUNJAB-AMERICAN COTTON. By M. Afzal and T. Trought. (*Ind. J. Agr. Sci.*, iv., **3**, 1934, p. 554.) From the data presented there is evidence that the most important cause of the production of motes is to be found in a nutritional defect of individual bolls, and that defective fertilization plays a very minor part. The presence of lethal factors in the Punjab-American cotton strains is not indicated by the data obtained so far. The motes are located on a definite pattern in the lock. The middle or the top of the lock has the least number of motes. The data from the sowing date experiments have shown that in the case of 4F the number of motes went on decreasing as the sowing time was delayed.

FIBRE, YARN, SPINNING, WEAVING, ETC.

159. COTTON: OPENING AND MIXING. Southern Textile Association. (*Cotton, U.S.*, 98, **6**, 1934, p. 59. Abstr. from *Summ. of Curr. Lit.*, xiv., **15**, 1934, p. 380.) In a discussion of methods of opening and mixing cotton preference was shown for cleaning before mixing, and mixing systems were briefly described. An unsuccessful attempt to mix Indian and American cottons was reported, but it was pointed out that the Japanese spinners are mixing these two types of cotton.

160. COTTON FIBRE: EFFECT OF GROWTH CONDITIONS ON DYE ABSORPTION. By W. M. Mebane and A. A. O'Kelly. (*Amer. Dyes Rept.*, **23**, 1934, p. 393. Abstr. in *Summ. of Curr. Lit.*, xiv., **16**, 1934, p. 410.)

161. COTTON FIBRES: MICROBIOLOGY. By B. Prindle. (*Text. Res.*, **4**, 1934, pp. 413 and 463. Abstr. from *Summ. of Curr. Lit.*, xiv., **18**, 1934, p. 473.) A collection of abstracts from the literature dealing with the destruction of cotton fibres at all stages of manufacture by bacteria and moulds.

162. COTTON YARNS: "COMBING VALUE"—I. By K. Kusebauch. (*Int. Cott. Bull.*, xi., 1933, p. 701. Abstr. from *Summ. of Curr. Lit.*, xiii., **21**, 1933, p. 553.) The combing value of a yarn is obtained from the values for standard deviation, variability index, dispersion, and fibre length extension calculated from the staple diagram obtained by Sieber's counting and measurement method.

163. COTTON YARNS: "COMBING VALUE"—II. By K. Kusebauch. (*Textilber.*, xv., 1934, p. 341. Abstr. from *Summ. of Curr. Lit.*, xiv., **18**, 1934, p. 475.) A more complete account, with data of the author's method for determining whether a yarn has been spun from carded or combed cotton.

164. OIL-SPRAYED COTTON: PROCESSING. Southern Textile Association. (*Cotton, U.S.*, 98, **6**, 1934, p. 60. Abstr. from *Summ. of Curr. Lit.*, xiv., **15**, 1934, p. 380.) The addition of from 0·2-0·3 per cent. of oil to cotton is an advantage in keeping down dust and fly. It is probable that the oil remains on the cotton in the drawing and spinning processes. Skeins from oiled cotton appear to have a better set twist on the reel than skeins from non-oiled cotton, and are free from kinks. The possibility of applying oil to weft to prevent kinking is suggested. In some cases

it has been necessary to decrease the weight of the laps when the cotton is oiled. Too much oil causes the cards to choke up. Equipment is now being developed for adding the desired percentage of oil to the cotton at the front of the card at the point where the web is condensed to a sliver. It is claimed that certain dyes fast to light and washing can be added with this oil at the front of the card.

165. COTTON, ACTION OF DILUTE NITRIC ACID ON. By G. Korsheniovsky. (*Textilber.*, **15**, 1934. Abstr. from *J. Text. Inst.*, xxv., **10**, 1934, p. 501.) Samples of cotton fibre were treated with 3·3 per cent. nitric acid at temperatures of 60°, 70°, 80°, 90°, and 100° C. for periods of 60, 35, 20, 15, and 10 minutes respectively, and the changes in strength, extensibility, α-cellulose content, copper number, and viscosity determined.

166. COTTON NEPS: REMOVAL IN PRELIMINARY SPINNING PROCESSES. By E. R. Fessmann. (*Textilber.*, **15**, 1934, p. 292. Abstr. from *J. Text. Inst.*, xxv., **10**, 1934, A478.) The possibility of removing existing neps and of preventing the formation of process neps in ginning, opening, scutching, and carding processes is studied, and the most suitable settings and other working conditions are indicated.

167. SAKAMOTO AUTOMATIC LOOM. By H. Sakamoto. (*Text. Rev.*, Japan, xxiv., **5**, 1933, p. 467. Abstr. from *Summ. of Curr. Lit.*, xiv., **18**, 1934, p. 463.) Already 32,000 Sakamoto looms are in use in Japan, and are generally appreciated. The new eight-year model of 1933 has a special let-off motion, the new feature of which is that the weight lever has a fulcrum movable according to the difference of diameter of the warp beam. There is also a new beat-up motion comprising an adjustable buffer and picking side lever.

168. HUMIDIFICATION IN TEXTILE MILLS. By E. Midgley. (*Text. Weekly*, xiv., 1934, p. 268.) Deals with the effect on yarn properties.

TRADE, CO-OPERATION, ETC.

169. THE LIVERPOOL COTTON ASSOCIATION. By A. C. Nickson. A very interesting account of the events leading up to the formation of the Liverpool Cotton Association in 1882, and of the many and varied activities of that body. The pamphlet is excellently illustrated.

170. LA GUERRE SEÇRÈTE POUR LE COTON: (THE SECRET WAR FOR COTTON.) By Antoine Zischka. (Paris, Payot, 1934. 20 fr.) The author of this interesting book is the son of an Austrian diplomatist, was educated at Oxford, and has travelled very extensively over the world (including most of the cotton countries). The general thesis of the book, with which few, perhaps, would be inclined to quarrel nowadays, is to prove the absolute necessity of an international plan, and of a reasoned economy, in dealing with the situation that at present exists. "The orthodox methods of liberal economy no longer give results; life has become so complicated that economic and social equilibrium cannot be re-established in a spontaneous and automatic way by the free play of natural forces." The statement is decidedly open to argument, but we fancy that the author would find many supporters.

The book is extremely well written, but is somewhat pronounced in the way in which it throws aspersions about. A friend who read it said, "I wish I were as sure of anything as he is of everything"—a just criticism, it seems to us; nevertheless, it affords much food for thought. Its weak points are those which are practically inseparable from journalism when unaccompanied by painstaking research. But the research needed to verify or disprove the statements in the book would be long, troublesome, and costly, and would matter little to its primary object.

The author regards the enormous unorganized competition for markets, that is at present going on, as a gigantic waste of money and energy that might better be applied to more useful ends. In this respect he comes into line with much advanced thought, and with many tendencies that are showing themselves in modern politics. Cotton, according to him, has been one of the great factors in causing many wars, even so far back as 575 B.C., when Babylon held the supremacy of the cotton market and Nineveh tried to take it away from her. Marco Polo was sent on his historic journeys to find the source of cotton and cotton goods, and Christopher Columbus was largely financed for his great voyage of discovery, which was "to find a route to India that was not blocked by the Mohammedans," by the merchants of cotton. Whilst 2,500 years ago it was two towns that fought for supremacy in cotton, now it is whole nations.

He begins his book by pointing to the scrapping of machinery that is going on in France and England, though a great number of the population of the world are without sufficient clothing. But here he hardly takes into sufficient account the fact that from a health point of view the tropical native who has to work out of doors is better without much clothing. In this statement he lays his finger upon one of the great weak spots in our present system of distribution and consumption of the materials, whether raw or manufactured, which we are every day producing with greater efficiency. If a "normal" crop—*i.e.*, one about equal to the actual consumption—sells at, say, 5d. a pound, and brings to its growers a return of, say, £10,000,000, then when a bumper crop, 25 per cent. larger, comes along, whether due to the bounty of nature or to greater effort on the part of the grower, it should at any rate bring in the same total amount, and sell at least at 4d. a pound. But this is just exactly what does not happen, except sometimes,* and there lies the tragedy of the position; the successful agriculturists are punished for their success. Hence comes the burning of raw coffee, the restriction or destruction of wheat, cotton, rubber, and other crops, to keep up the price. Yet if they could only be economically put into the hands of those who want them, they would add very considerably to the wealth of the world. Incidentally it may be noted that when England alone restricted rubber, although she had by far the greatest producing area, the result was not a success; the new rubber scheme which has just been started is international.

In the great struggle for market supremacy that is now going on four Powers are the leaders—England, the United States, Russia, and Japan. The exports of the last-named have risen at an almost fabulous speed; the author gives the figures of 14½ millions of yen in 1870, and 4,789 millions in 1933. Her population also is increasing by a million a year, and driving her towards external conquest.

For an immense period of time the growth of the world's cotton industry was very slow, on account of the difficulty of removing the fibre from the seed. Whitney's invention of the gin, which was preceded a little by the discoveries of Watt and Arkwright, enabled the industry to grow to its present colossal dimensions. These facts the author gives as illustrations of his contention that progress is due very largely to the work of scientific men, at first mainly engineers.

As another illustration of how things have gone on, he takes the history of the manufacturing industry in the United States. During the Napoleonic wars that country had to depend upon herself for cotton goods, and a fair industry grew up. England crushed this after the war of 1812 by dumping at cheap rates, and gradually the southern states which produced the raw cotton became more and more a mere appanage of Europe, exporting thither in 1860 the enormous proportion of 3,536,000 bales out of a total of 3,841,000 produced. Then came the Civil War, and after it America gradually began once more to manufacture, until

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* Carryovers, quotas, tariffs, and other things complicate the matter.

now she takes a great proportion of her own cotton for use in her own mills, which themselves are showing a distinct tendency to move from the north into the actual producing districts of the south.

The American Civil War marked the end of the period in which Lancashire was the supreme lord of the cotton industry. Since that time America and Japan have grown to proportions not so very different, and Russia is now showing signs of doing the same thing. The position in Lancashire has thus continually increased in difficulty. Hence among other things the formation of the B.C.G.A. some thirty odd years ago. From the point of view of possible wars, too, it was needful to obviate the risk of the failure of the American supply, and to the traditional English policy of the great river basins was added a politic of cotton.

When, however, the author goes on to state that the Sudan war, and others in Russia and elsewhere, were also carried on mainly for the sake of cotton, we think that he has surely allowed his imagination to run ahead of his judgment. And a little further on he states that England cannot now sell the cloth she makes with *her own* cotton from the Sudan and Egypt (not British possessions), India, and Australia, giving to the work of the Corporation a credit which has hardly yet become its due.

In a paragraph on p. 83 the author sums up in a pithy way what have been the experiences of the writer of this review in forty years of agricultural and economic work. "The history of petrol, of rubber, of cotton: the same thing always happens. Cotton cloths sell well; all the world plants cotton, and erects spinning and weaving factories. Then they sell no longer; all the world ceases to produce cotton, and throws itself into rubber or sugar, or something which looks more interesting at the moment. Too many tyres. Too much sugar. And all the world goes for petrol or gold, and when it gets there, there is a shortage of cotton. And one begins again. Two steps forward, three back. Everywhere waste. A ruinous system for all the world."

M. Zischka then proceeds to draw a picture of what we are pleased to call progress. While the total area and production of cotton (or other product) remains much the same, one country's industry is destroyed that another shall prosper. The native can no longer be made a slave in the old way; taxes are put upon him so that he is obliged to grow some "money" crop to pay his way. Political considerations are of much greater importance than economic, or than those of suitable climate, soil, or local conditions. He gives an unfavourable view of the part taken by England in the work that is going on, but admits that the rest of the world follows our example. This makes the stronger his plea for a reasoned plan of advance in the cotton and other industries. He quotes Lord Willingdon at the opening of the Lloyd barrage as saying that Sind's prosperity no longer depends upon the rains, but omitting to say that it really depends upon the markets. Roosevelt, who believes in a directed economy behind a tariff wall, destroys cotton; Stalin, who also believes in it, creates new cotton fields. Human nature being what it is, if one country applies a directed economy, the rest will immediately make, or try to make, their profit upon it. When England restricted rubber output, the Dutch industry went ahead. When Brazil valorized coffee, the English industry was rescued from its greatest difficulties. The real, and valid, argument for the present conditions of cotton planting in new places is that it is not a sound position for any one country to have a practical monopoly. The more countries that are engaged in the business, whether of growing or of manufacturing, so long as it can be done upon reasonably economic grounds, the better. But it should all be internationally planned. No single country, even when it holds such a comparative monopoly as Brazil held in coffee, or as the United States hold in "bread-and-butter" cotton, can do much singlehanded, and benefits its rivals at its own expense. All should work together.

The waste that goes on for want of reasoned international plans is terrible—like the waste of the beautiful country of England for want of proper planning. A colossal amount of money was thrown into the rubber industry in the great boom of 1910, and now, even with the conditions improved as they have lately been by the (international) restriction, is returning a very small percentage indeed. Not without good reason has M. Zischka headed his fourth chapter " Waste: the Scourge of our Times." While America is spending vast sums to reduce the cotton supply, England, Japan, Russia, Brazil, and other countries are spending as much to increase it, with the result that it remains more or less at the same figure. " One creates, and one destroys, at the same time." All these millions might have been devoted to something more useful. Coffee, wheat, and other crops show parallel phenomena. He quotes Sully's corner as another illustration in a different branch of the cotton industry. It was estimated that the mills of the world paid perhaps £100,000,000 more for their cotton than went to the growers and to the others concerned with the real work of production and distribution.

As other instances of economic waste M. Zischka takes what will, perhaps, be less agreeable reading to many—the transport waste in carrying cotton all the way to Japan, Lancashire, or the northern United States, only to carry it back again for sale to the growers as manufactured goods. The system, as he points out, is already showing signs of change in America and elsewhere; but it will change according as financial considerations dictate.

In a later chapter he describes the vast extensions that Russia is making in Turkestan, which he has himself visited. He foresees a great increase in output, with the possibilities of disaster on the cotton market, as happened with rubber, the preceding mascot; and he hopes that the four Powers chiefly concerned—England, the United States, Russia, and Japan—will come to some definite understanding and plan of action.

He goes on to deal with the expansion of Japan, and calls attention to the way in which the leaders of the industry (which does not suffer so much, as in other countries, from lack of co-operation) are planning to develop huge areas in Abyssinia, Mexico, and elsewhere, whilst the supply from Japan's own possession of Formosa is already assuming important dimensions. Going on to talk about what he terms the fratricidal war of cotton, wool, and artificial silk, he says that the engineering and scientific men, to whose work so much of the progress that might be shown is due, are losing patience at finding how their results are at the mercy of people who know little or nothing about the subjects in which the former are expert.

How can progress be expected to go on satisfactorily without proper organization ? This is the tune to which M. Zischka harps, and he returns continually to the primary motive. Certain obstacles, which are more or less purely local to one country, can be handled by a Mussolini or a Hitler, but such a thing as the cotton industry is only amenable to international handling, though a large part of the world still thinks that each country should fight (physically, if necessary) for mastery in any given industry—a thing that becomes more and more difficult and expensive as time goes on and the life of the world becomes more complicated. If two countries fight for the lead, the outsiders will probably pick up most of what is worth having. And the men who are deprived of work by all the changes in the distribution of an industry, whether of growth or of manufacture, are men who are often of little or no use in other occupations, could they even find them; whilst those men who take on the corresponding occupations in the commencing countries have all the work to learn from the beginning. Waste and ruin go on everywhere from want of proper international planning. Fear is the dominant motive. In cotton, which is an old industry, tradition counts for more than, for example, in motors or wireless. Speculation; waste; lack of standardization;

too many middlemen; unhealthy competition; waste in every direction. Such are some of the failings that M. Zischka urges against the present system. Such organizations as have appeared are national, and, if anything, increase the competition and waste. "The excess of liberty has killed freedom."

Mussolini on one side of the Atlantic and Roosevelt on the other are working for the restraint of unlimited and wasteful competition, whilst the industrialists in the "heavy" industries of France and Germany get along together better than do their Governments.

The book is one which, in spite of many errors in detail and attacks upon this or that proceeding (or individual), is one which it is pleasant to read (it is written in an easy and witty French), and which brings up many aspects of the situation that reveal themselves better, perhaps, to one who is not actually engaged in the struggle than to one who is. It is a book that should be read.

171. FORECASTING RAW COTTON PRICES. By W. H. Slater. (*Text. Weekly*, xiv., 1934, pp. 223 and 255.) A series of articles, of which the first deals with methods for forecasting raw cotton prices, and the second with the importance of the subject to the cotton trade.

MISCELLANEOUS.

172. SKINNER'S COTTON TRADE DIRECTORY OF THE WORLD, 1934-35. (Pubd. annually in October by Thos. Skinner and Co., London, Manchester, Bradford, Montreal, New York.) The twelfth issue of this invaluable work of reference of the world's cotton industry. The customary revision of details, in collaboration with the leading Textile Associations throughout the world, has been carried through, and valuable additions have been made to the particulars previously published. A new feature is the addition to the "Yarns Spun" lists of those spinners in Great Britain spinning Indian and Waste Yarns, together with the counts spun. The Hosiery and Knit Goods Manufacturers' section has been considerably augmented, and wherever possible the type of machines used has been indicated. The trade-names of articles manufactured by many firms and companies in this section are also given. The thumb-holes for ease of reference are labelled Contents; Index; Exporters, Merchants, Spinners, Manufacturers, and Doublers; Directors (British); Dyers, Finishers; Fabrics; Silk and Rayon; Hosiery and Knit Goods; Mill Supplies. All headings, indices, and explanatory notes are, as usual, printed in English, French, German, Italian, Spanish, and Portuguese. The directory is quite indispensable to all those in any way connected with the cotton industry. The price by post, inland and abroad, is 20s.; Canada and the United States, $7 (post and duty free).

173. STATISTICAL METHODS. By Dr. R. H. Pickard. (*Text. Rec.*, September, 1934, p. 18.) Deals with the subject under the following heads: Control of Quality; Research in Industry; Problems of Management and Production; The Statistician and Industry.

174. CATTLE IN THE TROPICS. By R. Cecil Wood. We have received from the author, who is Professor of Agriculture at the Imperial College of Tropical Agriculture, Trinidad, a copy of this pamphlet of 42 pages. Part I. deals with Species Concerned; Environment; Type resulting from Environment; Utilization of Cattle in the Tropics. Part II. is concerned with the Improvement of Cattle in the Tropics; The Improvement of By-Products; The Organization Necessary. The pamphlet is illustrated, and there is a bibliography of 83 names. Copies, price 2s. post free, can be obtained from the Author, Imperial College of Tropical Agriculture, Trinidad, B.W.I.

ADDENDUM.

175. NIGERIA: COTTON CULTIVATION, 1934-35. (*Half-yearly Rpt. of Dpt. of Agr. to September* 30, 1934.) *Northern Provinces.*—The demand for seed has been the largest on record, and it is confidently expected that the crop will be a record one. Rainfall in the chief producing areas has been satisfactory. In anticipation of a big crop arrangements are being made for opening 28 more markets than last season, 14 of the new markets being in the Kano Province. Discussions have taken place with a view to the re-organization of the market system in the Northern Provinces, and new regulations have been submitted for the consideration of Government which it is hoped will prove satisfactory.

Southern Provinces.—77 tons of Ishan seed were distributed as against 71 tons last year. The price charged was ½d. per pound instead of ¼d. per pound in the previous season. This may lead to a little more economy of seed. Weather conditions appear more favourable for a heavier yield than last year.

PERSONAL NOTES

It is with much regret that we have to announce the death of Mr. F. A. Tomlinson, which occurred at Harrogate on September 29. Mr. Tomlinson had represented the Manchester Cotton Association on the Board of Trustees, the Administrative Council, and the Executive Committee of the Corporation since its inception.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are at the corner of Millbank and Wood Street (entrance by the first door in Wood Street), immediately opposite the offices of the Crown Agents for the Colonies.

At the date of writing the following officers are on leave, or will shortly be arriving in England, from cotton-growing countries:

Ceylon	Mr. C. N. E. J. de Mel.
,,	Mr. J. C. Hutson.
Cyprus	Mr. R. M. Nattrass.
,,	Mr. P. M. Simeonides.
Fiji	Mr. H. R. Surridge.
,,	Mr. C. R. Turbet.
Gold Coast	Mr. R. J. T. Hooke.
,, ,,	Mr. G. E. Spurrell.
,, ,,	Mr. J. Wright.

Kenya Colony	Mr. J. Anderson.
,, ,,	Mr. T. J. Anderson.
,, ,,	Mr. W. D. D. Jardine.
,, ,,	Mr. T. B. Maclure.
,, ,,	Mr. A. D. LeP. Trench.
Nigeria	Mr. J. R. Brown.
,,	Mr. L. D. G. Cromwell.
,,	Mr. E. T. Holmes.
,,	Mr. J. R. Mackie.
Tanganyika Territory	Mr. C. J. Buckley.
,, ,,	Mr. J. C. Eyre.
,, ,,	Mr. P. J. Greenway.
,, ,,	Mr. C. Harvey.
,, ,,	Mr. N. V. Rounce.
Uganda	Mr. T. R. Hayes.
,,	Mr. W. J. M. Irving.
,,	Mr. R. B. H. Murray.
Zanzibar	Mr. A. J. Findlay.
,,	Mr. I. G. C. Squire.
West Indies: Jamaica	Mr. F. E. V. Smith.

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CHROMOSOMES; AND THE WORK OF PROFESSOR RUGGLES GATES

THIRTY years ago, even twenty or ten or less, very few people knew what a "chromosome" was. Probably most folk had never even heard the word used. Still less was known, even a very few years ago, about the "genes" of which a chromosome is made up. Today, on the other hand, while one can hardly perhaps say that these are household words, or that they are familiar to the man in the street, they are nevertheless words that most educated folk have heard in use. Many even, especially if they have anything to do with agriculture or gardening, know more or less accurately what the words mean.

It has long been known that plants, like animals, are composed of minute cells, and that in the middle of each cell is a denser body termed the nucleus, presumably the centre of the activities of the cell to which it belongs. Little, however, was known of it beyond the fact that in the nucleus was a still denser body termed the nucleolus or little nucleus. In the nucleus, when cell-division (by which the plant or animal grows, or replaces damaged tissue) occurred, little dark-staining rod-like bodies, now termed chromosomes, sorted themselves out, arranged themselves in a more or less parallel way, and split lengthwise. The halves then drew apart into two equal masses, one of which made the nucleus of each of the two new cells that were formed out of the single old one that divided. But this was about as far as knowledge then went. We remember the late Sir Arthur Shipley (Master of Christ's College, and Chairman of the Governing Body of the Trinidad Agricultural College before Sir James Currie) saying in a lecture, "The nucleus of a cell is like the Master of a college; it is there, and apparently the cell cannot get on without it, but no one has ever yet been able to explain what use it is."

This is all changed now. Gradually it has been found out that the number of chromosomes is constant for the same species—*e.g.*,

52 in American cotton. In ordinary cell-division each chromosome divides into two, lengthwise, and one half goes into each of the two new cells, so that each of them, like the cell from which they were formed, contains (in American cotton) 52 chromosomes. But when the *sexual* or germ cells are being formed by cell-division in special parts of the plant or animal, the process that goes on shows important differences from the ordinary cell-division. The chromosomes form up in pairs, and of each pair one is now known to have been derived from the male parent of the plant producing the germ cells and one from its female parent. Having lined up, these chromosomes, which are now going to produce two germ or sexual cells, do *not* divide lengthwise, but one *complete* chromosome of each pair goes into one of the two cells produced from the one with which we started. The result is that each germ cell contains only half the normal number of chromosomes—*e.g.*, the germ cells of an American cotton plant contain only 26 of the 52 that occur in the body cells, while the other 26 are found in another germ cell. Only when the male germ cell meets the female, whether on this or upon another plant, and fusion takes place, do we again come back to body cells with 52 chromosomes. The entire body of the new plant or animal is then produced by ordinary cell-division from the fertilized egg.

So far as we know, and so far as the actual results of cross fertilization can tell us, the chromosomes that go into a germ cell are mixed at random, some coming from the male, some from the female parent of the plant that produces the germ cell. And in any one germ cell there may be, perhaps, any possible combination from all A, all but one A, all but two, down to as many A as B, and then up again to all but two B, all but one B, and all B. The middle combinations, if the chromosomes go at random, would obviously be much the most likely to occur, and the combinations all A or all B might occur once in a blue moon.

There is not space to go into further details of the many and interesting discoveries of the structure and behaviour of the chromosomes that have been, and are being made; but it is clear that we have now *begun* to get a grip upon the scientific understanding of breeding, an art which previously was to a considerable extent a matter of chance, utilized and governed in practice by a careful selection of the forms that were the most promising, according as utility, beauty, or other characteristic was aimed at.

Not only has the behaviour of the chromosomes been studied in great detail, but their structure has also been the object of much attention. It was gradually found out, not only that all the heredi-

tary characters of individuals were, so to speak, bound up in and carried into the offspring by the chromosomes, but that individual characters, or sometimes little groups of characters, were determined each by a small and definite portion of the chromosome, which is technically termed a *gene*—the unit of inheritance so far as we yet know. Each chromosome is made up, apparently, of a longer or shorter row of genes, one after the other.

Slowly, very slowly, by complicated series of cross-fertilizations and other measures, and by exchanges of chromosome segments, which occur from time to time, and by treatment with X-rays, which sometimes breaks the chromosomes, it is becoming possible to locate some, at any rate, of the actual characters of the plant in particular genes of the different chromosomes. In maize, a map of the genes as they are arranged in the ten pairs of chromosomes has already been prepared. Dr. Harland, in Trinidad, is gradually obtaining a map of the corresponding locations in cotton, so that in time it will become possible, doubtless, to say exactly, with reference to a cell-nucleus, where the main determinant for each character (there may be two or more determinants, in different places) lies in the chromosome; and this will make it easier to breed for any particular character that is wanted, especially when once we have also learnt how to detach a particular definite piece from a chromosome.

This detachment of a piece of a chromosome may, and does, occur at present, but we can only produce such breakages by bombarding the chromosomes with X-rays, and then selecting among the resulting forms.

If a little bit breaks off, carrying as it does the impulse, if we may so call it, to produce certain characters, and joins on to another chromosome that also carries the same impulse, then the impulse will be doubled, and the character may be much more pronounced, a fact which may be of very great importance indeed in the production of new and improved varieties.

As was described by Hurst (Vol. VIII., 1931, p. 103), the use of X-rays and of other means is coming in, by which (and it will doubtless become more and more easily possible) it is feasible to alter certain genes, causing in them sudden changes which we term mutations. These, when inherited, may bring out in the offspring characters that are quite different from those of the parent. Whether or not they will be characters that are of any value is at present purely a matter of chance, but it is possible that as we learn more about the process we may be able to exercise some control.

When, to all these new equipments and weapons for improvement

of varieties, we add the old and well tried ones of cross-fertilization, selection, and so on, it is clear that the resources at our command for the improvement of the breed of plants and animals (including man himself) are every day becoming more and more extended and available, as our knowledge of chromosomes, genes, and their behaviour and structure continues to improve.

Just as science is now daily applied in manuring, in fermentation, in many other operations that were once done by rule of thumb, so a science of plant and animal breeding is rapidly growing, and being every day more and more closely applied to the actual work of improvement. But in this connection it is quite clear that we do not know about the chromosomes and the genes even a small portion of what we must know if we are to bend nature to our will, and to breed new forms which will carry with them all the desired characters and not carry also the undesired. We have gone an appreciable distance, and have produced some valuable and striking results, but we have a very long and arduous road yet to travel, and, as in everything else, the law of diminishing returns will one day begin clearly to show its working—as, in fact, some speakers at the Conference held last July suggested was even now the case—and the rate of progress will slacken.

The more we know about the chromosomes, about their construction, about the individual genes of which they are made up, about the distribution of these genes along the length of the chromosomes, and about the ways in which we can alter this distribution —whether by rearrangement, as sometimes happens now, or by detachment—the more shall we know about the laws which underlie the transmission of characters from parent to offspring, and how most easily to get rid of undesirable characters and insert desirable.

There are many, and all about equally necessary, ways in which the problems offered by chromosomes may be dealt with. One may, for example, have a good cotton in some particular country, but which is very subject to some disease or pest that is common there, and which attacks it so much that its profitable cultivation is impossible. This was the case in South Africa a few years ago—the jassid made success a very doubtful proposition indeed. Mr. Parnell, by successful crossing with types that were immune to jassid attack, and by elimination of undesirable characters, produced the cotton known as U.4, which made the cultivation of cotton for profit in South Africa a possibility. This is work of the most valuable kind, but, as was pointed out by various speakers at the recent Cotton Congress, such work is more likely to lead to conspicuous success in places like South Africa, where cotton has as yet had little or no

attention, than in places like India, where it is an old-established cultivation.

Such work is very distinctly applied science. One may go a little further back towards pure science, where the work done is not such as is likely to lead to immediate and profitable commercial results, but which may, in the end, produce results of greater and more wide-spread value; and one may do such work as is being carried out under Dr. Harland in Trinidad, where an endeavour is being made to locate the genes in the chromosomes of the cotton plant, and to breed types that carry larger numbers of useful genes. These types are not bred —cannot be, except in the actual place—to suit the conditions of any particular region, and will usually require further breeding there, somewhat of the kind that we have described in connection with U.4.

Or, lastly, one may take another and even wider line, and may start by taking all the relatives of the cotton plant, not merely the different varieties of cotton itself. One may take all that belong not only to the genus *Gossypium*, but to the other genera, like *Hibiscus* (which includes the well-known Eastern shoeflower, the rozelle, the okra, etc.), which are closely related, belonging to the same subfamily of the Malvaceæ; or even those genera which are in other and more distantly related subfamilies of the same family, like *Malva* (mallow), *Malope*, *Abutilon*, *Lavatera* (tree mallow), *Althæa* (marsh mallow, hollyhock), *Anoda*, *Urena*, etc. Many of these names are familiar in greenhouse and garden plants. The Malvaceæ, as a whole, form a family of medium size, and include a great many familiar plants and very many of the weeds of cultivation in different parts of the world. They are also, as a family, rather more than usually subject to the attacks of insect pests, so that when the local pests of some malvaceous plant or other find a person settling down to grow cotton in their neighbourhood, they are liable to think that a millennium has dawned, and to fall over one another in their desire to make prompt use of the opportunity.

It is these related forms, other species of the cotton genus *Gossypium* itself, but still more the species of the other genera of Malvaceæ, that Prof. Gates is now engaged in studying in detail. They probably contain characters of value that do not occur in cotton, and which can only be brought in by some process that begins by their crossing in fertilization with cotton. People who have no experience will probably say—well, cross them with cotton and have done with it. But this is just exactly what does not happen.

When one crosses two species, and still more two genera, even though nearly related, one crosses plants or animals whose cells in

many cases contain different numbers of chromosomes, and so the normal fusion, let us say, of American cotton with 52 chromosomes—

$$\begin{array}{ccccc} 52 \longrightarrow & 26 & \times & 26 & \longleftarrow 52 \\ \text{body cell} & \text{germ cell} & \times & \text{germ cell} & \text{body cell} \\ & & \downarrow & & \\ & & 52 & & \\ & & \text{body cell of new generation} & & \end{array}$$

—does not take place. If one crosses a 52-chromosomed species with a 26-chromosomed (Indian cotton, for example), one brings into the meeting of the two parents a somewhat awkward complication. On the one side the germ cell contains 26 chromosomes, and on the other side only 13. One might imagine that one would simply get a new form with 39 chromosomes, because, after all, each group, the 26 in one case and the 13 in the other, is carrying the whole of the necessary determiners of characters. But though this is right enough for the body cells, where so long as all the determiners are there, a little irregularity does not matter, the case is very different when the formation of the germ cells begins. The chromosomes, which, to make new body cells, have simply to divide longitudinally, have now to separate out into pairs, each member of the pair carrying the same (or corresponding) characters as the other member. But with a certain lot of characters occupying 26 chromosomes in the one parent of the hybrid and only 13 in the other, it is clear that the separation cannot be properly managed; and so, when such a hybrid is attempted, few or none of the seeds are fertile. The hybrid is sterile, showing the special character that has always been associated with hybrids.

But in such sterile species-hybrids a number of cases are now known in which the hybrid has, as a rare event, doubled the number of its chromosomes by their splitting lengthwise. Such a form will be fertile because all its chromosomes will find mates. It will combine the characters of the parent species, and may show the vigour that is so often characteristic of hybrids. Its chromosomes will in number be the sum of those in the two parent species.

If we could double chromosomes at will, we should have in our hands one of the greatest weapons for breeding improved forms that can be thought of at present. But as yet we are far from that happy time, and must still depend largely upon luck. But it is work of this nature which Prof. Ruggles Gates is taking in hand. He has at his disposal, for research work, a portion of the old Botanic Garden which occupied the centre of Regent's Park. It includes a space of open-air flower beds, and a few glasshouses, with a labora-

tory building in which five or six workers can be accommodated. Cotton, of course, is only one of several groups of plants in which cytological work (work upon the microscopic construction of the cell, and behaviour of its parts, especially the chromosomes) is going on. One man, for example, is at present working at the oil-producing Brassicas (the genus includes the cabbage, cauliflower, Brussels sprouts, turnip, rape, kohl-rabi, etc.), and another at the Cardamomums (including principally the spice so much used in the East, cardamoms).

On entering the grounds from the Inner Circle of the park, one comes first upon large beds of forms of Œnotheras, the evening primroses, plants which have given so much information to students of genetics and origin of species, like Prof. Hugo de Vries, Prof. William Bateson, Prof. Theodore Stomps, Prof. Ruggles Gates, and others. Looking at the large range of variation that is shown—as may be seen in these beds—sometimes even by the offspring of a single plant, one may perhaps feel a passing regret that cotton is not equally variable.

Prof. Gates has now got together, some out-of-doors, but more under glass, a collection of some 10-15 genera, represented by some 60 to 70 species, all belonging to the family Malvaceæ, to which cotton belongs. With these he intends to try all possible crosses, for doubtless many will altogether refuse to hybridize. Most of the crosses that do succeed will no doubt be sterile, or all but sterile, but some fertile ones may be hoped for, especially if chromosome doubling can be induced; and, of course, every effort will be made towards this end.

Prof. Gates has also succeeded in getting some of the other species of *Gossypium*, which do not actually yield cotton themselves, but which carry valuable characters which, if they can be introduced into the actual cotton plant, might be of very great value to it. Such characters are drought resistance, about which a good deal was said on the first day of the recent Conference. The actual species which he has growing in the hothouses at present include *Gossypium Armourianum, G. Davidsonii, G. Harknessii* (all Lower California), *G. Klotschyanum* (Galapagos). Even if none of the crosses succeed or produce valuable offspring, a vast amount of information, which will be of great value for future work, will have been obtained.

It will hardly be needful to remark that single crossing of all these forms will not take us very far towards the goal; there will have to be much back-crossing with the parents, and much crossing with other forms, to say nothing of selection and other processes that will have to be called into play.

For direct and immediate improvement of cotton itself, the results will be of the nature of chance, in which the odds will be against one. It is very unlikely that there will be many fertile hybrids, and even if one of the non-fertile ones were a treasure, to work with hybrids that had to be created anew for each crop would be too costly and troublesome for any practical purpose. One must hope for duplication of chromosomes to occur.

Curiously enough, one of the most promising ways at present of getting such duplication is through the method of graft-hybridization, about which Prof. Weiss has written such interesting papers and Prof. Neilson Jones has recently produced a useful book. One sometimes gets by grafting, which should not be ultra-difficult in malvaceous plants, a hybrid form like the well-known *Cytisus Adami*. Here the common laburnum was used as the stock, and upon it was grafted *Cytisus purpureus*, with the result that a hybrid form grew out, with some of the characters of the laburnum, some of those of the cytisus. Now if the stem that thus grows out is cut back, it often regenerates from the cut surface, and there is a chance that the new shoot may have a doubled number of chromosomes. There are other ways of inducing this doubling, including the use of X-rays, and in one way or another we may hope that Prof. Gates may arrive at valuable results, which, even if they cannot be directly applied in the field, may be of great value, for example, to the workers at such a place as the Trinidad Station, or to the direct workers in the field—in other words, to the first two of the three classes of genetic workers that we have indicated.

[And *cf.* Abstr. 291 and 297 below and pp. 165, 167.]

AMERICAN COTTON LEGISLATION

BY

JOHN A. TODD, M.A., B.L.

IN the issue of January, 1934, under the title of "Finance, America, and Cotton Prices," the writer outlined the history of the various efforts, financial and agricultural, made by the American Government to raise cotton prices since the season of 1931-32. That article brought the history of events down to the end of November, 1933, and by that time the Government's policy had shown itself as following two main lines—(1) the raising of the general level of prices by the devaluation of the dollar; and (2) the raising of cotton prices by restricting production and by making advances to the growers to enable them to hold their crops. The stages reached in the carrying out of these two policies by November, 1933, were (1) that the Government's fixed gold price had been raised from the par value of $20.67 per oz. to $33.56, and (2) that after securing in 1933 a "special abandonment" of 10,396,000 acres out of the total of 40,852,000 planted, they had in September, 1933, agreed to advance 10 cents per lb. against the 1933 crop, and also to make the same payment against the Pool cotton which the growers had taken over at 6 cents in June of the same year as part of the inducement offered to them for the reduction of that year's acreage.

During the winter of 1933-34 both these lines of policy were extended. In January, 1934, the devaluation of the dollar was carried still further to 59.06 per cent., which made the gold price $35.00, and at that figure it has remained ever since. At the same time it was announced that the authorities would either buy or sell gold at that price, so that in effect the United States were now back on the gold standard.

In December, 1933, the Administration announced the terms for the reduction of acreage in 1934 and conditionally also in 1935. The main point was that in consideration of certain payments the acreage in 1934 was to be restricted by 40 per cent. of the "basic acreage," which was the average of 1928-1932, and turned out to be 41,486,000 acres. The Act also provided for a maximum restriction of 25 per cent. in 1935, if the Government announced its decision to that effect by December 1, 1934. The details of the

payments to be made in compensation for this reduction of acreage are very complicated, but, briefly summarised, they consisted of a leasing payment and a parity payment, both of which were based on the average yield per acre of the land concerned.

But the experience of 1933, when in spite of special abandonment the crop was practically the same as in the previous year, had called attention to the necessity of restricting not only the acreage but the crop, and in January, 1934, Senator Bankhead introduced a Bill which was to limit the quantity ginned according to a quota fixed for each county and state on the basis of its previous production. In the form in which it finally passed in April the limit was 10 million bales of 500 lbs. net, equivalent to about 10,500,000 bales of the ordinary unit of 478 lbs. net, and any planter producing more than his quota could only market it on payment of a tax of 50 per cent. of the current price.

The next step again lay with the inflationists who, from about March, 1934, had been agitating for various measures to raise the price of silver, and early in June an Act was passed which authorized the President to buy up the whole silver stock in America at 50 cents an ounce, and also to buy abroad up to a total which would provide 25 per cent. backing against the U.S. paper currency. In view of the extremely complicated position with regard to the metallic backing required for the various kinds of silver certificates, gold certificates, Federal Reserve notes and National Bank notes, it has never been quite clear how much this would amount to. All that can be stated with certainty is that the purchases so far made, although very large, are still far short of the total required. So far, however, it is not possible to trace any direct inflationary effect as the result of the purchases either of gold or silver under the above legislation.

The next development, however, was not legislation but an intervention of Providence. When the Government's estimate of acreage appeared on July 9 it turned out that the restriction scheme had been only partly successful. Forty per cent. restriction all round would have brought the acreage planted down to about 25 millions, but the planters who did not come under the Leasing Plan had added about 3 million acres to the total, so that the actual figure was 28,024,000. With a ten years' average yield this should have given a crop of 10,135,000 bales of 478 lbs., so that it was doubtful whether the Bankhead quota would come into play. As early as May, however, there had been reports of severe drought in the Corn Belt which looked like extending into the western part of the Cotton Belt, and as the summer progressed these reports be-

came steadily worse until, when the first Bureau Report of the season came out on August 8, the crop forecast was only 9,195,000 bales. The final figures, however, proved to be not quite so bad, for the drought broke in August and not quite too late, so that the crop figures rose with every successive Bureau and in December reached 9,731,000 bales. Most of the Central and Eastern states exceeded their quota under the Bankhead Act, but the Western states, especially Texas and Oklahoma, suffered a dreadful reduction (the average yield in Oklahoma was only 57 lbs. per acre). To ease things a little, therefore, the Government in September introduced a special arrangement under which those who were short of their quota could buy "tags" from those whose crop had failed, at the rate of 4 cents a lb.

In the meantime, of course, prices advanced sharply as the result of the crop failure, and in August were well above 13 cents. At that stage the Government announced their intention to lend again on the 1934 crop, the basis price (which is for Low Middling at Southern points) being 12 cents. This is supposed to be equivalent to about 12.50 cents for Middling at New York.

Optimism with regard to prices, however, soon received a sharp check. The small consumption figures in America, as the result of the three months' restriction of spindle activity and the textile strike in September, were accompanied by a sharp reduction of exports due to a heavy swing-over of consumption abroad from American to Outside Growths, and American cotton interests became greatly alarmed at the prospective effect on the position of American. The result was an agitation for the substantial modification in 1935 of the various restrictions of production and price-raising measures of the Government. The response to this, however, was a sharp reduction of prices for distant months, and when, towards the end of October, October 1935 futures came on the Board in the principal markets, the quotation of the new crop months showed a discount of about 30 American points on July. This put the American administration in a very awkward dilemma. If the restrictions were maintained in 1935, America stood to lose the world's market for its cotton crop; if they were dropped, the effect would be a fall in prices, and the Government now held about 5 million bales! The final outcome was that on November 29 the Government announced that the maximum restriction of 25 per cent. on the acreage would be enforced for 1935. On the basic acreage, and estimating the free acreage at the same figure as last year, this indicated an acreage of about 33 millions, and on the basis of the ten years' average yield a probable crop of 12 or 13 million bales.

Under the Bankhead Act, if the quota was to be continued into 1935, it was necessary to secure a two-thirds majority on a referendum of the planters. This was taken in December and resulted in a large majority in favour of continuance, though on a very small vote, and this result was largely due to an appeal by the President, in which incidentally he favoured an exemption of small growers whose crop was less than two bales. There remained, however, the question of the actual figure to be placed on the Bankhead quota for 1935. Under the Act it was not necessary for the Administration to fix this figure until April 1, but it was expected that, in line with their previous policy of making the quota not less than the probable crop, the figure would be about 12 million bales. On January 17, however, the Administration announced that the quota would be only 10,500,000 bales of 500 lbs. net, but at the same time it was stated that there were certificates outstanding from 1934 for about 700,000 bales and that these could be used for the 1935 crop. The total of 11,200,000 bales of 500 lbs. net would be equivalent to about 11,700,000 of 478 lbs.

Even this, however, was substantially less than the probable crop on the 25 per cent. acreage reduction, and the publication of the Bankhead quota was therefore accompanied by a new announcement that planters could restrict their acreage in 1935 by 35 per cent., and that the Government would pay for this larger reduction. It may be noted here that the terms of compensation offered to the planters for the 1935 reduction of acreage were on the same lines as in 1934, but with certain slight modifications in favour of the planters. Applying the new figure of 35 per cent. to the basic acreage and assuming that as many planters would give effect to it as in 1933, the indicated result was a probable acreage of about 30 millions, including free acreage as before, and on the basis of the ten years' average yield a probable crop of about 10,850,000 bales. Thus once more the Administration had adjusted the Bankhead quota so as to leave a substantial margin over the probable crop. But if the 35 per cent. reduction is not generally adopted, or if, as in 1931 and 1933, the average yield should prove to be high, the crop might, after all, reach 12 or even 13 million bales, and then the Bankhead quota would become the limiting factor.

It will be seen from all this that the American Administration have been kept very busy trimming their sails to every changing wind of opinion, but the net result is that they are now committed once more to a very severe restriction, both of acreage and crop for 1935. That, however, did nothing to allay the anxiety about the

dwindling of exports, on which by this time the Senate Agricultural Committee had begun its hearings, and one of the proposals submitted to them was a revival of the plan for allotment payments to the growers for cotton consumed in America so as to enable the balance to be exported at world prices. At the same time the Government began to take other steps to ease their position, one of which was an attempt to get rid of their stocks by disposing of part of the balance of the Pool cotton left over from crops prior to 1934. During December and January about 300,000 bales were sold to spot houses in this way, but that movement seems to have come to an end for the time.

The next suggestion was a proposal that the Government should take steps to secure international agreement to restrict cotton production in order to dispose of the surplus. This was apparently inspired chiefly by the huge Brazil crop, but the trade agreement which has since been under negotiation with Brazil makes no mention of this so far as is yet known. But all this did not satisfy the politicians, who immediately on the reassembly of Congress produced a deluge of further proposals. Senator Bankhead, for example, pressed for a declaration that the Government loan policy would be continued into the 1935 crop, and at the same time proposed that the time limits applicable to the various Government holdings should be abrogated, so that the Government's interest in the Carryover would be continued indefinitely. On the other hand it was proposed that the surplus cotton still in the Pool should be handed back to the farmers against their Bankhead quotas of 1935. Then it appeared that the President's promise of exemption from the quota to producers of less than two bales required legislation. Finally, the demand for legislative reform of the cotton futures markets was revived.

This final reversion of the Government policy to severe restriction for 1935 ought to have raised prices again, but unfortunately this was counteracted by a new cloud on the financial horizon. Early in January attention began to be drawn to certain test cases in the Supreme Court of the United States on the constitutionality of the Gold Clause, under which obligations of all kinds to pay in gold had been abrogated by Congress in June, 1933. It was soon announced that if the Court's decision should be adverse to the Clause, the Government would immediately introduce corrective legislation which would be made retroactive; but there was considerable anxiety as to the speculative disturbances which might be expected during the interval between the issue of an adverse decision and the putting of this legislation into effect, especially as it might mean an amend-

ment of the Constitution. The repercussions of this anxiety were seen in the extraordinary fluctuations of the exchanges between New York and London and Paris, which at one time in January carried the rate down to $4·82.*

It remains to consider the effect on consumption of all these efforts to restrict the supply and to raise the price of American cotton. As will be seen from the following table, based on Garside's monthly figures, the swing over in the World's Consumption from American to Outside Growths has been very serious. In 1932-33 the figures were 14,405,000 bales American against 10,307,000 Outside Growths. During 1933-34, however, the proportions rapidly changed and in June, 1934, the consumption of Outside Growths was more than that of American. That has been true for almost every month since, and for the first half of the current season Garside's figures are American 5,883,000 bales and Outside Growths 6,501,000 bales, or an apparent excess of 618,000 bales of Outside Growths. Only once before in history have the statistics of consumption shown such an excess. That was in 1930 and 1931, when the Federation figures for three half years in succession showed a similar position, and in the worst of these three half years, that ending in January, 1931, the figures were 5,273,000 and 5,886,000, or an excess of 613,000 bales of Outside Growths. If Garside's figures are confirmed by the Federation, it will therefore be a new record.

WORLD'S COTTON CONSUMPTION—AMERICAN *v.* OUTSIDE GROWTHS
(RUNNING BALES 000's)

	1932-33.		1933-34.		1934-35.	
	American.	*O.G.*	*American.*	*O.G.*	*American.*	*O.G.*
August ..	1,067	749	1,262	917	980	956
September ..	1,168	787	1,195	848	846	1,028
October ..	1,205	868	1,203	925	1,079	1,119
November ..	1,200	855	1,197	953	1,007	1,126
December ..	1,145	914	1,025	972	916	1,115
January ..	1,192	891	1,218	987	1,055	1,157
1st Half	6,977	5,064	7,100	5,602	5,883	6,501
February ..	1,110	889	1,116	954		
March ..	1,201	919	1,208	997		
April	1,135	856	1,161	1,000		
May	1,340	895	1,171	1,010		
June	1,375	851	980	1,027		
July	1,267	833	944	991		
2nd Half	7,428	5,243	6,580	5,979		
Season's Total	14,405	10,307	13,680	11,581		

* See page 110 for the result of these cases.

It is hardly necessary to pile up other evidences of the same tendency, but it may be noted in passing that up to the end of January, 1935, America's exports for this season were only 2,991,000 bales against 5,020,000 at the same stage last season. In Liverpool the stocks of cotton of all kinds at January 25, 1935, consisted of 258,743 bales of American and 584,044 bales of all other growths, against 485,040 and 429,779 bales respectively at the same date last season. Perhaps the most significant fact of all is that the Liverpool Cotton Association is seriously considering the introduction of a new American Futures contract which will include certain Outside Growths.

All this is the result of the fact that the prices of Outside Growths have not on the whole followed the rise in American.* It is generally assumed that the cause of the trouble is that the price of American cotton has been artificially raised by crop restrictions, by the holding movement resulting from the Government's loan policy and by monetary inflation, but it is necessary to distinguish between these various causes. Monetary inflation extends to nearly all the important cotton-growing countries, for none of them remains on the gold standard, except America, which has now stabilized (temporarily) after a period of inflation. The real question, therefore, lies between the other two causes mentioned. Has the rise of prices been due to the holding policy of the American cotton-growers, backed by the Government loan system, or is it no more than the natural result of the huge cut in the 1934 crop ? The distinction is important because the holding policy may be described as an artificial state of affairs while the restriction of the crop is a physical fact. One answer to this question will be found in the figures of the world's supply and distribution of American cotton, which are given on p. 110.

It will be seen that the season's supply—*i.e.*, crop plus carryover—has been declining since the record crop and carryover figures of 1931-32 and 1932-33, but the reduction of the season's supply in 1934-35 is fully 4 million bales. Now the history shown in this table establishes on the whole a very close correlation between the season's supply and the season's average price, and if that correlation holds true for this season, the average price in New York should be at least sixteen cents rather than thirteen, which has been about the average for the first half of the season. That argument, of course, must not be pressed too far, because such a correlation is only proof of a tendency which may be upset at any time by special conditions, and the conditions just now are definitely abnormal because of the swing

* For the actual extent of the change in relative prices reference may be made to the tables in our usual statistical article on page 133 of this issue.

AMERICAN SUPPLY, CONSUMPTION AND PRICES.

Season.	Carry-over at Beginning of Season.	Crop.	Season's Supply.	Consumption (Federation).	Season's Average Spot Prices.	
					Liverpool.	New York.
	Running	bales 000's	(ex-linters	throughout).	Pence.	Cents.
1920–21	5,656	13,271	18,927	10,033	11·89	17·89
1921–22	9,141	7,978	17,119	12,728	11·37	18·92
1922–23	5,028	9,729	14,757	12,594	14·92	26·30
1923–24	3,235	10,171	13,406	11,080	17·66	31·11
1924–25	2,665	13,639	16,304	13,270	13·76	24·74
1925–26	3,324	16,123	19,447	13,736	10·77	20·53
1926–27	5,358	17,755	23,113	15,777	8·15	15·15
1927–28	7,484	12,783	20,267	15,407	11·17	20·42
1928–29	4,952	14,297	19,249	15,066	10·52	19·73
1929–30	4,332	14,548	18,880	13,015	9·09	16·60
1930–31	6,249	13,756	20,005	10,901	5·71	10·38
1931–32	8,816	16,629	25,445	12,316	4·82	6·34
1932–33	12,798	12,710	25,508	14,171	5·48	7·37
1933–34	11,550	12,664	24,214	13,534	6·02	11·09
1934–35	10,509	*9,500*	*20,009*	*11,750*	—	—
1935–36	*8,250*	*11,750*	*20,000*	—	—	—

over of consumption from American to Outside Growths. This, therefore, simply brings us back to the same question again, How far will the substitution of Outside Growths for American go throughout the remainder of this season and in future seasons? All that can be said in the meantime is that for the current season there is no sign of any material change in the tendency, though it must be remembered that since the early months of this season there have been substantial reductions in the crop prospects for Outside Growths, especially India, Egypt and probably also Russia, so that it is now rather doubtful whether the total production of Outside Growths in 1934-35 will do more than equal the figure of 1933-34.

For 1935-36 it is, of course, impossible to make any guess at the production of Outside Growths, but an estimate may be made of both crop and carryover in the case of American. Judging by the first half of the season, the world's consumption of American in 1934-35 is likely to be slightly under 12 million bales, which should make the carryover at the end of this season fully 8 million bales. The 1935 crop to be marketed may be anything from 10¾ to 11¾ million bales, which means that the season's supply for 1935-36 will probably be 19 to 20 million bales. The point is that, as far as can be seen at present, the season's supply next winter is likely to be no more than during this season, and may easily be a million bales less; and the Government will probably be holding at least 5 million bales of the carryover at a minimum cost of 12 cents.

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SOIL FERTILITY IN THE SUDAN GEZIRA

BY

N. W. BARRITT, M.A.,

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(1) DRAINAGE.—It is not possible that anyone familiar with cotton growing in the Sudan could be led to believe that millions of pounds had been wasted and the land irretrievably ruined by the absence of a drainage system in the Gezira. But there are doubtless many readers of Dr. Balls's article in the last issue of this Review who must wonder how it can come about that his advice should pass unheeded for two decades by successive agricultural advisers to the Sudan Government.

The present writer has never visited the Sudan and his experience of Gezira soil is confined to handling a lump of it in the laboratory at Rothamsted, but the statements in Dr. Balls's article cannot be allowed to pass unchallenged.

In this article Dr. Balls quotes from a recent statement that "the principal factor which has depressed the yield of cotton, even in years when damage from disease was not serious, appeared to be connected with lack of aeration of the soil and the effect of that condition on the plant's root development," and he concludes that this is occasioned by lack of drainage. Surface drainage for the disposal of storm water is applicable anywhere in the interests of sanitation, but this has no bearing on soil fertility. The normal meaning of drainage applied to soil is the improvement of aeration by the removal of surplus water (and no one has ever complained of excess water in Sudan soil), and in the one experiment in which waterlogging was achieved a marked increase in yield resulted.

Both Dr. Joseph[1] and Dr. Greene[2] have shown that the problem in the Sudan is to get water into the soil. Owing to its high clay content, in some places it required thirty days' flooding for the water to penetrate to a depth of 2 feet.

In support of the theory of lack of soil aeration Mr. Bailey said at the Conference held last year[3] that heavy rainfall in May and June prevented the drying out of the land and the development of deep cracks. Dr. Balls, however, has ignored this entirely. No system of drainage will prevent this surface puddling effect of rainfall on a heavy clay soil. Dr. Balls refers to a weathered skin of clay, but

does not mention the 60 feet of clay above the water table. As a preliminary measure he suggests the use of Dempster type drains at 70 to 80 cms. deep to provide " a stream line of water and oxygen which would improve the permeability of the contiguous soil." At a later date further drains would be inserted at a depth of 150 cms. Some further explanation appears to be needed, however, as to how water and oxygen can improve the permeability of clay. Many soil physicists and agriculturists would be glad to know how this magic works in Egypt. The low yields per feddan obtained in Egypt in recent years do not give evidence of any compound interest system at work in that country. It may be of interest to state that high salt content is associated with increased permeability in Gezira soil[4] and also in any other heavy clay soil.

The heaviest rainfall in the Gezira never penetrates below 25 cms., and two days after irrigating Dr. Green found that the moisture content at 60 cms. was increased from 22 per cent. to only 23 per cent. Since the moisture-holding capacity of the soil is 40 per cent., how is Dr. Balls going to persuade the drains to run? Supposing it were possible by a very lavish use of irrigation water to saturate the top 60 cms., any water that entered the drains would just as easily leak out into the drier soil below. This prediction is amply confirmed by the attempts at mole draining carried out last year and reported by Mackinnon in the annual report.[5] If it were possible to raise the water table in the Sudan similar to that in Egypt, the drainage of the Gezira soil would then be possible.

(2) THE REAL PROBLEM IN THE GEZIRA.—The fluctuations in the yield of cotton in the Sudan have now become traditional, and the disturbing feature is the general downward trend since 1920. These fluctuations in yield have been the subject of very intensive study during the past fifteen years by the Sudan Agricultural Research Service. In 1925 Dr. Crowther showed that the yield was negatively correlated with the amount of rain falling during May and June. This correlation has been confirmed in subsequent years, and it is now considered that the amount of the early rainfall is a very reliable basis for predicting the subsequent crop. It is too early to say if the downward trend of these fluctuations is due to some progressive change in the climate of the Sudan, or to the progressive development of the various diseases to which the crop is liable.

The introduction of irrigation has increased the humidity of the Gezira during the cotton growing season, but it is not known how this could affect the climate during the early and more critical time of the year.

Dr. Joseph pointed out the effect of irrigation on the salt content of the soil, each season's irrigation adding 12 cwts. of salt per acre, equivalent to an increase of 0·01 per cent. salt per annum through a depth of 6 feet. This rate of increase will not account for the rapid decrease in yield even on cotton grown every year on the same land, since adjacent land on a rotation system, but with similar salt content, shows much higher yields. Nitrogen starvation and disease appear to account for most of this deterioration in the case of continuous cotton.

The ready response of the crop to nitrogen every year at first led to the theory that the harmful effect of early rain was due to early nitrification followed by loss of nitrogen before the crop was sown in August.

Nitrate analyses carried out over the period of the summer rains and subsequent growth period have not confirmed this theory. No significant difference in nitrate was found after the sowing dates whether preceded by early or late rain. Greene[6] also found that the changes in nitrate content of the soil do not extend below 12 inches, so that subsoil nitrate does not appear to be a factor affecting the yield of the crop. It is now thought that the effect of early rain is due to some more profound change in the condition of the soil. Early rains are said to prevent the development of deep cracks or cause them to close up earlier and thus diminish the aeration of the subsoil. This later results in anaerobic conditions during the growth of the cotton crop and its subsequent deterioration.

In support of this theory it was found that subsoiling without disturbance of the surface soil resulted in increased yield.

This explanation, however, is open to two serious criticisms:

(1) The oxygen absorbed by deep cracks in the soil would be displaced by the first heavy rain whenever it occurred, and the amount remaining would depend upon its solubility in water, which would be the same in all seasons.

(2) The apparent absence of nitrate reduction is not consistent with anaerobic conditions.

The beneficial effect of deep cracking of the soil and also that of subsoiling is more probably due to the deeper penetration of water and consequent improved root action of the plants. If this is so, the *depth* of the cracks will be more important than their *duration*. Unfortunately, there appear to be no records of the depth to which the cracks develop in different seasons.

The nitrate tests would probably be found more useful if carried out by the Devarda method instead of by the di-sulphonic acid

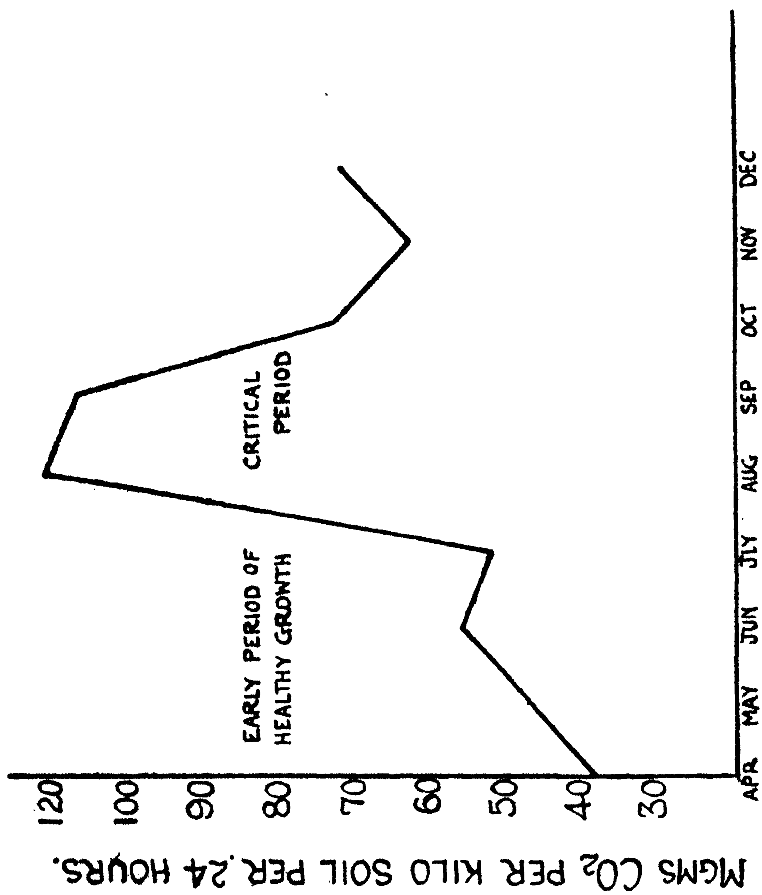
method, and separate nitrite determinations should be made. The formation of nitrite is one of the first indications of anaerobic conditions in soil. These data are now being obtained by the chemical department in the Gezira and should provide very useful information.

Some interesting results bearing on the main problem are given by the rotation experiments on cotton in the Gezira. The rotations under trial are as follows:

(1) Cotton, fallow, fallow.
(2) Cotton, dura, fallow.
(3) Cotton, dura, dura.
(4) Cotton, lubia, fallow.
(5) Cotton, dura, lubia.

The results obtained over a number of years show no difference between fallow or lubia preceding cotton, but whenever dura precedes cotton a significant decrease in yield occurs. Dura produces a more resistant crop residue than lubia, and it is in the time and rate of decomposition of this residue that the solution of the problem is to be found.

F. Crowther,[7] who appears to be the first to introduce microbiological methods in the study of cotton soils, has shown that there is normally a high peak of carbon dioxide evolution during September. The curve shown opposite was obtained from the soil of the cotton observation plot 57 and represents the changes in respiration rate of Gezira soil under cotton following a previous year's fallow. How much of the rise during September is due to the effect of plant residues in the soil and how much is due to the stimulus of the cotton roots, it is not possible to say without further data. It is well known that the bacterial population of the soil below a growing crop increases rapidly with the developing root system and is largely responsible for the increased rate of respiration of the soil. It does appear extremely probable that in heavy clay soils such as those of the Gezira, under irrigation, the limits of aerobic respiration may be easily reached, so that anaerobic conditions result. The presence of decomposing crop residues in competition with a rapidly increasing root respiration may quite suddenly result in root asphyxiation. It frequently happens that the crop makes a good start in August and September only to develop unhealthy systems very rapidly in October. The supposed anaerobic conditions in the subsoil do not account for the sudden collapse of the plants so satisfactorily as the above explanation. The changes in moisture, aeration and nitrate content occur chiefly in the first foot of soil. The development of a deep



SOIL RESPIRATION OF COTTON OBSERVATION PLOT. (F. CROWTHER).

root system is a gradual process and not likely to affect the sudden changes in the metabolism of the plants such as occur under Gezira conditions.

Crowther showed that the effects of dura in the rotation can be explained by the decomposition of the crop residue in the soil during the growth of the cotton. This decomposition may cause a temporary shortage of nitrogen and raise the rate of soil respiration to a dangerous level, resulting in anaerobic conditions. By means of early watering in May and June combined with the application of nitrogen, this decomposition can be hastened and completed before the cotton crop is sown in August, and its harmful effects entirely avoided. It should be noted that this remedy is in contradiction of the theory accounting for the harmful effect of early rain.

Crowther then made the interesting suggestion that the growth of weeds (non-legumes) induced by early rains will have a similar effect, only more so, to a dura crop in depressing the subsequent cotton crop.

This effect is now being investigated in the Gezira and the results will be awaited with great interest.

Incidentally this theory has the additional merit of explaining the surprising result announced by Bailey at the Empire Cotton Conference last July—viz., that surface cultivation of the soil in preparation for the cotton crop results in a less yield than leaving it untouched. Evidently the best way to deal with crop and weed residues in the Sudan is to leave them on the surface where they can respire without damaging the roots of the cotton.

Thus the problem in the Gezira appears to be not so much dependent upon soil aeration before the rains as upon the overtaxing of the soil respiration during the growth of the crop. Further work requires to be done on the microbiology of heavy clay soils under irrigation conditions, to test the accuracy of these conclusions.

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DRAINAGE IN THE SUDAN GEZIRA

BY

G. H. DEMPSTER

THE following note has been received from Mr. G. H. Dempster, Alexandria. The writer states that it was written before Dr. Balls' paper appeared in the January issue of the Review, and may, therefore, be of some interest. (*Cf.* p. 36, January issue.)—ED.

"From information kindly supplied through the Gezira Agricultural Research Service and the Gezira Chemical Laboratory, it would appear that in general the soil of the Gezira presents some undesirable features in respect to soil fertility. Average soil is apparently readily permeable only to a depth of perhaps a foot from the surface, below which it becomes rapidly less permeable until a practically impermeable stratum is reached at between 2 and 3 feet below ground level. This compact soil is generally salty, but, because of its impermeability, the salt appears to be more or less fixed and does not to any marked extent tend to rise to the surface. Drainage is considered practicably impossible under such conditions. Yet experience has proved, and is proving the world over, that arid lands under irrigation must have drainage, sooner or later, if soil sterility is to be avoided.

"The present physical and chemical structure of the soil is apparently largely the result of physical conditions in respect to rain and temperatures experienced in the Gezira. Being at the present time high above the influence of the Blue Nile and receiving two-thirds of the annual rainfall of about 10 inches in July and August, the impermeable subsoil is found probably at the natural limit of penetration of such a rainfall. If this be so, it is logical to assume that a radical change in physical conditions, especially those affecting soil humidity, would sooner or later change the physical and chemical structure of the soil. Undoubtedly special treatment, such as the application of gypsum or digging bastard trenches, would greatly accelerate the transformation, and the following suggestion is put forward by the writer.

"The Gezira should be gradually transformed into two, three, or four series, or chains, of basins, constructed to contain about 2 metres depth of water, rotations of series being made to conform to the agricultural programme followed. The chain of basins would be constructed and managed on the Egyptian system, fed preferably by a very large main canal running down the Central Ridge of the Gezira. A series would be filled in

July-August with water which would otherwise run to waste into the sea, and by January all the water should have been absorbed or evaporated, thereby eliminating any need of running off. During those five months of flooding the water would probably have penetrated far lower than the average level reached by rain or ordinary irrigation water, especially if it were found possible to dig 6-foot bastard trenches spaced at say 100 m. apart, the refilling being treated with gypsum. It is further suggested that the trenches should, before being refilled, be provided with special porous pipes of a suitable diameter and graded to serve as drains which would discharge into collectors. These would reduce the salt content and check the tendency of a rise in the salts when the basins were drying off. Cultivation of the surface after flooding would be advisable in order to reduce evaporation.

"In the following flood season this series of basins would not be flooded again, but would go to cotton or other crops.

"The results anticipated by such a system are as follows: (1) Change in soil profile. (2) Increased porosity of soil providing deeper root development. (3) Retention of humidity for benefit of following crops. (4) Decrease in salts. (5) Improvement of surface by silt. (6) Institution of a subsoil drainage system, which is an ultimate necessity for maintaining soil fertility. (7) Benefit to Egypt, especially in high floods, of utilizing excess flood water.

"If the contention is raised that the scheme is today economically impossible, attention should also be directed to the alternative—the probability of ultimate soil sterility if the land is allowed to remain in its present condition.

"In putting the project into practice no drastic reversal of past policy or the immediate construction of gigantic new works is suggested. A commencement might be made where flooding to a depth of 2 m. with silty water could be best carried out without altering radically the present canalization. Preferably a system which ensures rapid silting would be most suitable—*i.e.*, one which provides for a steady flow of water through a basin; but this is a detail, though an important one, which could be considered later. The principle of raising the soil level by 25 to 30 cms. should be kept in mind, as by special arrangements of basins uniform silting of such a depth in one single year is a practical possibility, as has been proved by over thirty years' silting experience in Egypt. Naturally, the area so silted annually would be comparatively small, though the discharge water would be utilized for filling lower basins of a much larger area."

A DAY IN THE LIFE OF A COTTON INSPECTOR IN THE SUDAN

BY

EDWARD INGE

THE scene opens in the Inspector's bungalow. This is a large three-roomed house with a wide mosquito-proof verandah all round it. It stands in a ten-acre garden, whose hedges and trees provide the only shade for miles around. Trees are not encouraged by the authorities, for they harbour insects and other pests that damage the cotton. The sun, a huge orange ball, is poking its head up above the horizon, and that is the signal for about twenty-six different kinds of birds to greet the day with song. It also wakes the house-boy, Osman, and bids him rise and make his master's tea.

January is a cold month in the Blue Nile Province, and the Inspector is sleeping on the verandah under four blankets. The clatter of tea-things at his elbow calls him to face another day. Opening his eyes, he observes the following phenomena from his vantage point.

Gaily plumaged birds swoop and chatter among the thorn trees that mark the boundary of his garden. Others are dotted about on his lawn in front of the house, seeking not early worms, but early insects. His two ducks, Swan and Edgar, make a ridiculous picture as they proceed in their pompous way from the canal bank to the kitchen door, where their breakfast awaits them. Waddling from side to side, Edgar, in flagrant disregard of the laws of etiquette, is in the lead, and Swan close behind. From the stables come those noises so well known to horse lovers: the stamp of hoofs on the cement floor; the "hiss" of the syce as he grooms his charges; the good-morning snort and whinny of Pythias as he greets Damon, his stable mate.

Meanwhile the Inspector, shivering slightly, for the temperature is but 50° and a strong north wind blowing, is sipping his tea and shaking off the mists of sleep.

"The shaving is ready," announces Osman, appearing from one of the rooms, and the time has come for getting up.

A quarter of an hour later, dressed in sweater, coat, muffler and breeches, he calls Osman and orders Pythias to be brought round.

Meanwhile he collects his notebooks and pencil and makes out his plan of campaign for the pre-breakfast ride.

Pythias' arrival calls him out, and he goes forth to greet his dark bay steed. As soon as the horse hears his master he tears his head from the syce's grasp and whickers his welcome. As the Inspector descends the steps, Pythias drops his head and reaches for the nearest hand, which he nuzzles like a dog. "Want your sugar, eh?" Pythias' ears prick up as he hears the well-known voice, and he tugs gently at his master's sleeve. "Now where did I put it?" Pythias gladly helps in the search, sniffing first one pocket, then the other. "Ah! here we are, old boy," and with a luscious scrunching Pythias puts away the titbit.

Directly the Inspector is mounted, Pythias is eager to be off. They canter down the winding drive between the thorn trees and out by the canal. Pythias is given his head and off they fly for about a quarter of a mile: he shakes his head and snorts with pleasure as he gallops along. Ah! the exhilaration of that first gallop on a winter's morning, with the wind whistling past your ears and the feel of a willing horse beneath you. But work must be done, and at the first 90-acre block of cotton Pythias is steadied to a trot.

Picking is in full swing at this time of year, but the natives do not like cold mornings, and are not inclined to rise too early: which, considering that their sole covering is a cotton sheet for protection against the bitter wind, is not surprising. But the cotton must be picked in this holding before the water comes down in its rotation, and so the Inspector must harden his heart and call the people forth.

Adjacent to the cotton are a dozen or so grass houses put up each year by the White Nile Arabs, when they trek east for the cotton picking. Smoke is filtering through the thatch of every *tukl,* and the occupants are obviously having their early cup of tea. The Inspector espies a figure framed in the entrance of one of the houses and hails him. The native comes up and greets him in the usual way:

"May your day be happy," to which the Inspector replies in like terms.

"Now, come along. You must get on with the picking. Call out the *naas* (people)."

The man lifts up his voice, and in his own particular language calls his people out. It is a slow business, as one by one the young men and girls, old women and old men, and young women with their babies on their backs file faltering forth. An almost unbelievable number of people appear from each house. With the floor space less than that of a bell tent, these straw houses disgorge some twelve

or fifteen people from each narrow door. The Inspector greets them cheerily, and at last gets them into the cotton, which they start picking, stowing the cotton into the folds of their clothing, which they have arranged for that purpose in some ingenious way. One old man lingers behind and then comes up and says:

"Is it true that the price for picking has gone up by half a piastre?" This question is asked on an average ten times a day.

"Who told you that?" counters the Inspector.

"Oh! I heard it."

"Is not sixpence a basket good enough pay for you?"

"Oh yes. Yes. I just thought . . ." He passes slowly on to rejoin the pickers, who are now talking gaily among themselves, and a few blithe spirits are singing.

Pythias canters on, and soon they meet the tenant who owns the cotton. (It should be explained that all the cotton is leased to tenants in 10-acre lots, and they receive a percentage of the profits.)

"Blessings upon you," cries he, leaping off his donkey.

"And on you be peace," replies the Inspector, reining in his horse. "But why so late? Your people are all out and picking."

"May I please have a chit for some more cotton sacks?" answers the man, carefully ignoring the previous remark.

"Here you are—but really, Mohammed Ahmed, you must rise earlier."

"Yes, of course I will: God be with you," and off he goes, legs swinging and slippers balanced precariously from each big toe.

The next block they come to is in process of watering. A pipe from the canal takes the water down a channel, and thence it debouches on to the cotton field, where it is attended to by the tenant. Here there is not much to say, save to warn the natives to water the cotton lightly.

And so the tour proceeds until, glancing at his watch, the Inspector finds that it is ten minutes to nine. But as he is turning for home he hears a wheezing and gasping behind, and sees a man running towards him, arms waving and breath coming in wheezy gasps.

"What's the matter?" asks the Inspector.

"One—moment—please—while—the—breath—returns—to—my—belly," he gasps, and stands there, chest heaving.

"You ought to run every day, and then you would not lose your breath."

"Oh! Excellency, I have been swindled."

"How?"

"I picked three and a half baskets for Mustapha Ali and he will not pay me."

"Why?"

"I don't know."

"Did you clean the cotton after picking?"

"I cleaned it absolutely."

"All right: give this chit to Mustapha Ali and come with him to my house at midday."

"Thank you, thank you."

But his protestations are cut short by Pythias, who is all impatience to be gone. They wheel about, and off they gallop for home and breakfast.

Ali the syce is waiting at the door to take hold of Pythias as his master dismounts, and with a parting pat on the glossy neck, the Inspector enters the house. Breakfast these cold mornings is a hearty meal, and after a fish course and four eggs the world seems a better place. With his pipe going satisfactorily the Inspector can sit back and relax awhile.

By ten o'clock the sun is quite warm, and sweater and breeches are doffed in favour of a vest and shorts, for by midday the temperature will be round about 90°. Damon is ordered round, but he is in a bad temper this morning. He snaps at the sugar, and takes it without a by-your-leave or thank-you, and then rears up on his hind legs and tries to fall on the wretched Ali. He, however, skips out of the way, still keeping hold of the bridle as the Inspector approaches slowly, talking the while until he sees the angry white disappear from the brown eyes. He mounts, and off they go down the drive to find a host of tenants at the end, all wanting chits for more sacks. These having been dealt with, they choose another direction, and the tour of inspection continues.

Coming towards them as they trot along are two camels. On one is paterfamilias, a lean and wizened man with a small beard and incredibly dirty clothes. His camel is being led by his eldest son, a youth of about fourteen, and as dirty and unkempt as his father. But it is the other camel that arrests the eye. On the hump of this ship of the desert is placed the marital couch, on which are perched the two wives with their progeny at their feet. They are sitting side by side on the bed, and the *lares* and *penates* are hung all around them. It is obvious who is the favourite wife, for she has a beautiful white garment that drapes her slim figure, and a white gauzy veil over her head. Her partner is much older and clad only in a dirty blue sheet. They make a noisy passage as they go on

their way. Pots and pans jangle on one side; calabashes and poultry on the other. Yes, poultry, for five of these wretched birds are hanging by their legs from one bedpost. How they survived the hours of travel in that inverted position remains a mystery; but one or two were still in voice, albeit the cackling was somewhat adenoidal.

After leaving this White Knightly equipage, the Inspector met the sheikh of the village from which most of the tenants come. This venerable old gentleman, with a long white beard and of a most benevolent rotundity, slid gracefully from his white donkey and came up to horse and rider. This time the greetings were longer drawn out and more fulsome.

"May your day be happy."

"May your day be happy and blessed."

"Greetings upon you."

"How are you?"

"Blessings upon you."

"Blessings and greetings."

And throughout this talk the old man was shaking the Inspector's hand fervently. After some further parley and circumlocutions, the patriarch said:

"Would your Excellency give me the pleasure of coming to tea this afternoon?"

"Thank you very much."

"Thank *you.*"

Another hand-shake, and on they go again.

The warmth has brought all the people out again, and each 10-acre plot has its quota of pickers. Here and there a party of twelve or more are sitting round a huge pile of cotton that looks like a heap of snow. Taking up a handful they shake it and beat it, to remove any bits of leaf or boll that might be there before putting it on another heap of even more dazzling whiteness. Horse and rider go on, up one block and down another,—there is swearing at one tenant, congratulation for another, and encouragement for a third. At half-past twelve they turn for home, where lunch and bed await the weary Inspector.

As Ali leads Damon away, the native comes up with Mustapha Ali, and it is obvious that there is a certain amount of tension between the two. The Inspector is reminded of an essay he had to write for his College Entrance Examination, entitled "Capital and Labour will never agree." He goes into the house, and conducts the case through the mosquito wire.

"Now—what's the trouble?"

Immediately the floodgates are opened, and simultaneously they tell their tale, their voices rising as they try to make themselves heard.

"*Hoi!*" bawls the Inspector in stentorian tones, and in the staggered silence that follows, adds: "If you don't shut up I shall go indoors and not hear your case at all. Now, Mustapha Ali, listen to me, and you—you remain silent until I tell you to speak. What is all this business? I can't have tenants employing labour and then not fulfilling their contract. This man says he is owed for three and a half baskets of cotton, that is eight and three-quarter piastres. What about it?"

"But, Excellency, I would have paid it, but I could not find the man."

"Is that so?" asks the Inspector, turning to the picker.

"Well, I had to go and see my brother, who was ill."

"Oh! And did you ask for the money when you got back?"

"I only got back today."

"Well, you donkey, how can you expect to get the money if you do not ask for it? Mustapha Ali, have you got the money?"

"No."

"Well, go and get it and bring it here tomorrow morning, and you, you wait outside the garden tomorrow morning, and I'll give it to you. Go and pick some more cotton."

The Inspector leaves the two men and goes gratefully to the cool darkness of his room. He lies back in a Morris chair until luncheon is announced. After a light meal he takes his book and goes to his bedroom after telling Osman that he does not want tea today, but wants the car at 3.30.

Sharp at the hour appointed he is awakened by a discreet rattle on the door knob; Osman will never learn to knock on a door.

"It is three hours and a half, Excellency."

While he is dressing, he hears the car being brought round to the front of the house. On the way to the village he stops at the cotton-sack station, which is a very hive of activity. A Bresil driven train has brought some eight or nine empty trucks along, and a gang of a dozen natives are rolling the sacks from the weighing machine to the trucks, while a further gang lift them up and swing them on board. The whole operation is done in perfect rhythm, the music being supplied by the natives, who sing the whole time. It is an incredibly bawdy song that they sing, but fortunately it is in their own argot, and unintelligible to the Inspector, or indeed to any but their own race. A very autocratic native stands by the weighing

machine and takes over each pair of sacks as they are brought in by camel. The sacks are bound with cord to either side of the camels, and as these laden beasts swing ponderously down the road they look for all the world like some antediluvian nightmare in bathing "wings."

But it is getting late, and tea is waiting the Inspector, so on he goes to the village. He is met at the outskirts of the village by the sheikh's son, himself a bearded man of about forty, who greets him deferentially and leads the way to his father's house. The Inspector drives slowly behind him, steering a tortuous way round the mud houses; goats and donkeys, sheep and camels move grudgingly aside; hens and ducks run squawking for safety to the dark interiors of the huts as the car approaches.

The sheikh's house is an imposing place entirely surrounded by a high, tessellated wall. The sheikh himself stands at the entrance to welcome his guest as he descends from his car, and the greetings are repeated. The old man leads the way through the gateway, leaving his son to keep at bay about eighty naked children who have clustered round the car. Inside the courtyard are tethered his horse and his donkey, his camel and a cow. Not a soul is to be seen within this place, as, with a courtly gesture, the old man leads the way into his domain. They pass first through an anteroom almost empty of furniture, through another room—that is, the sheikh's living-room—and into the guest-room, where the repast is ready laid out.

The Inspector, rather overcome by all this grandeur, is wondering whatever he is going to talk about when once they sit down. However, he is shown to a divan covered by a clean white sheet and similarly covered cushions are placed behind his back. He sits down, and the sheikh follows suit, but on the floor, which is covered with beautiful rugs. Softly clapping his hands, he summons his slave, a freedman really, who pours out two bottles of very fizzy lemonade. These the Inspector has to drink by himself while the tea is being prepared. Meanwhile the old sheikh sits cross-legged on the floor gazing at nothing and waiting for his guest to speak. The latter, after gulping down the warm hell-brew, asks whether the sheikh's durra crop of that year was satisfactory. That starts the ball rolling, and soon he learns all about the amount of durra harvested and the fluctuation in the price of the grain.

Tea is now being poured out, and the guest requests his host to partake, which he does after a few polite disclaimers. Four cups of strong, sweet and milkless tea are drunk, with some difficulty, by the Inspector, and with loud and appreciative gulpings and

smackings of the lips by the old sheikh; and then the conversation is resumed. This time the sheikh asks about aeroplane travel, for he has heard that the Inspector flew home by Imperial Airways on his last leave.

The arrival of coffee makes the Inspector groan inwardly and wonder whether he has room for any more. The coffee, however, is really good, though in his candid opinion six cups of it are rather over the odds. But the sheikh looks so hurt when his guest tries to wave away the coffee pot that he has to persevere. Eventually he makes his excuses and struggles to his feet. Preceded by the sheikh, he leaves the house and gains the car. Shaking his host by the hand, he thanks him for his hospitality; to which that worthy replies:

"It is an honour that you should come to my house, and I thank you for it."

The sun is now almost out of sight. The whole of the western sky is lit with a wonderful orange glow. Cattle, lowing gently, are being driven back to the village, and the dust that they make rises like a mist over all the landscape. As the Inspector drives homewards a long string of camels is being driven along the canal bank, and their silhouettes against the sunset sky present a wonderful and never-to-be-forgotten sight. For a brief space twilight reigns and then night is here, fallen like a curtain over this Gezireh Plain, which man has changed from an arid desert into a fertile land.

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RESEARCH IN ENTOMOLOGY AND MYCOLOGY AT THE UNIVERSITY OF MANCHESTER

THE grants made by the Empire Cotton Growing Corporation to the University of Manchester are utilized to promote original research in two branches of Biological Science, namely Entomology and Mycology. The work is carried out by research assistants specially appointed for the purpose, and attached to the Departments of Botany (Mycology) and Zoology (Entomology). In accordance with the general policy of the University, the investigations deal with fundamental problems, such as the life-histories and behaviour of fungi and insects, which have a direct or indirect bearing on cotton problems. In addition to carrying out original investigation, the research assistants collect and study all scientific literature relating to cotton problems which falls within their own department of work, and are prepared to give information and expert advice to other workers on cotton problems.

ENTOMOLOGY

Some years ago it was suggested that, as the cotton thrips (*Heliothrips indicus* Bagnall) was one of the more important insect pests of cotton in the Sudan, useful work might be done in this country on the biology of thrips with special reference to the cotton plant. It was not possible to obtain the cotton thrips itself, so the onion thrips (*Thrips tabaci* Lind.), a cosmopolitan species which has been known to attack cotton, was chosen as the subject for the experiments. The habits of the two insects are not unlike, and the damage done to the plant is similar. Thrips attack the leaves of the plant rather than the bolls and, by piercing the leaves and sucking out the cell contents, cause them to shrivel and fall off, thus weakening and, if it is very heavily infested, killing the plant.

The first experiments were devoted to attempts to find the effect of varying temperature on the life-cycle of *Thrips tabaci*; to discover the relation between the feeding habits and the plant lesions caused by this pest; and more especially to endeavour to find the relation between the amount of water supplied and the infestation of the plant by the thrips. Some of the results obtained suggested that

"one factor concerned in the infestation of a plant by thrips is the influence of heavy water supply upon the texture of certain soils in promoting surface caking which will act inimically to soil-pupating species of thrips." That is, as many thrips spend part of their life-cycle buried in the soil, it is possible that if the soil becomes caked the insects will not be able to make their way out and will die before reaching the plant. This suggestion was followed up by growing two blocks of cotton plants, in one of which the soil was kept well loosened at the surface, while in the other block the soil was allowed to become caked on the surface; the results obtained supported the suggestion put forward that caking of the soil is injurious to the insects, as the plants grown in tilled soil were more heavily infested than those in the other block. Further experiments were made with plants grown in a light soil which did not cake readily, and others grown in a heavy clay soil which formed a hard crust. In both types of soil the infestation of the plants was higher when the surface was kept tilled; but the plants grown in light tilled soil were much more heavily infested than those grown in tilled clay soil. The date at which the plants were sown also appeared to have an important effect on the infestation by thrips. Each year the first thrips had been obtained at the end of April or the beginning of May, so different blocks of cotton seed were sown, one block in March, one in April and one about the middle of May; again two types of soil were used, one a heavy clay soil and the other a light loam. The earliest sown plants had thus reached a fair size before the first appearance of the thrips, and were very much less affected by the pest; this was particularly marked in the plants grown in light soil. Plants grown in clay soil did not show such a striking difference in infestation when sown at different dates; but in each block they were less heavily infested than the corresponding block of plants grown in light soil, thus corroborating the findings of previous experiments.

Series of experiments were also made to find the effect of varying temperature and humidity on the life-cycle of *Thrips tabaci*, and it was found that the degree of relative humidity is of great importance for the survival of the thrips larvæ. A relative humidity of 75 to 85 per cent. appeared to be the optimum for the development of the larvæ, but 65 to 75 per cent. relative humidity was nearly as favourable; at high temperatures (over 35° C.) over 70 per cent. relative humidity was required for the insects to reach maturity. Temperatures of 16° C. to 25° C. were the most favourable for the development of the thrips larvæ, and temperatures over 36° C. and below 10° C. were definitely unfavourable, although a few insects

survived at 39° C. and at 9° C. Low temperatures prolong the time taken for the insect to become mature, but the degree of relative humidity does not seem to have any marked effect on the length of the life-cycle in *Thrips tabaci*. Further experiments on the same lines are still being carried on.

Studies of the life-history of one of the leaf-hoppers (Jassidæ) have also been made. Jassids form one of the most serious cotton pests in South Africa, the damage to the plant being of a similar type to that done by thrips, the insect piercing the leaves and sucking out the cell contents. Some of the experiments made with *Thrips tabaci* were repeated, using the leaf-hopper. The surface caking of soil had no effect on the infestation of the plants by leaf-hoppers; but this was to be expected, as the jassid, unlike thrips, spends all its life on the plant and does not bury itself in the soil at any time. Other differences were that plants receiving a large amount of water were more heavily infested than those receiving a small amount, and the plants which were planted early in the season were more infested than those planted later. A very small insect parasite which attacks the eggs of the leaf-hopper was discovered.

One of the cotton stainers (*Dysdercus howardi* Ballou) was brought alive from Trinidad about three years ago, and this insect is being bred in the laboratory. Observations on the number of eggs laid by the females, on the fertility of the eggs and the time taken for their development have been made, and the results of these observations compared with similar observations made by other workers on different species of stainers. Experiments are under way to find the optimum conditions for hatching the eggs of *Dysdercus howardi*, for moulting in the young stages and for egg-laying in the adult stainers.

The series of experiments dealing with the cotton stainers have not yet reached a sufficiently advanced stage for any very definite conclusions to have been drawn, but in the experiments with thrips it is interesting to note that the laboratory results are supported by the findings of workers in the field. In the Sudan it has been noticed that a higher degree of infestation by thrips generally accompanied a lower supply of water; increased water supply to the plants has been recommended as a measure to control the pest. This suggestion was supported by the laboratory experiments, but these also demonstrated that the inimical effect on the insects of the larger water supply was due to the influence of the water on the texture of the soil and not, as has been suggested, to the direct effect of the water on the insects (one series of experiments showed that

thrips were able to survive prolonged contact with water) or to the influence of excess water on the constitution of the cell-sap of the plant. This result emphasizes the fact that the question of methods of cultivation is of great importance in the control of insect pests.

Mycology

The main work in Mycology in this department recently may be summarized in the words "the study of the interrelationship of a fungus with its host." This interrelationship is being approached in the widest possible sense, that which includes the circulation of knowledge, not only of the direct effect of the fungus on its host plant, but also of the details of its life-history, structure and reproductive processes, together with similar details of other members of the group to which it belongs. In fact, the department is pursuing not the study of a single isolated parasite, but the investigation of a complete group of well-known parasitic fungi.

The special group which has been chosen for this survey is that of the Erysiphales or powdery mildews. This group is a sharply defined natural one, the members of which show such well marked similar characters as to be obviously related. All the members of the family are plant parasites, some of them being common pests on plants of economic importance such as wheat, vine, hop, gooseberry, and cotton plants.

The mildews are surface parasites on herbs and trees, and are easily recognized, especially in early autumn, by the presence on the leaves of spherical brown fruit bodies containing numerous resistant spores. The fruit bodies may be confined strictly to the lower surface of the leaves—*e.g.*, the mildew on hazel—or may extend to both surfaces of the leaf, the flower stalks and even on to the fruits themselves—*e.g.*, the gooseberry mildew. If the same plants are examined earlier in the year, the leaves are seen to bear the white threads of the fungus in the vegetative condition. From this surface weft of threads, root-like sucking branches are sent into the cells of the outer skin of the leaf and sometimes even deeper into this tissue. This finally results in the death of large patches of leaf tissue. At this stage the fungus is seen to produce vast quantities of a fine white dust—the short-lived summer spores which gave to the group the name of the powdery mildews. These summer spores are the means by which the fungus spreads infection from leaf to leaf and from plant to plant.

The member of the group which attacks cotton is a species of

Erysiphe—a form related to the mildew of wheat. It appears on the leaves of the cotton plant late in the year, and although it is by no means a serious pest, it is very common and must inevitably cause a weakening of the plant since the parasite enters and eventually destroys parts of the leaf tissue.

The work on the life-history and structure of a number of these fungi is well in hand. Two species have been investigated extensively so far. One, a species of *Erysiphe*, the commonest member of the group in England, occurring on many garden plants and weeds, has been studied. Special attention has been paid to the mode of origin of the fruit body and fertilization, together with the development and formation of the spores. Similar details are also now available for the hop mildew (*Sphærotheca humuli*). Work of the same nature is in progress on a species related to the vine mildew (*Uncinula*) and on the member of the group which occurs on hazel (*Phyllactinia corylea*). It is hoped that shortly the form on cotton will also be available for similar work. In all cases not only the main details of the life-history, but also the question of cell and nuclear division, are being investigated.

Running in conjunction with the work on the life-histories of the mildews is the second and more difficult question of their parasitism. So far only one growing season has been available for this side of the enquiry. It is hoped, however, to continue the study of this very important side of the survey during the coming season.

The question of the reinfection of the host plant each year is one which has already engaged attention. These parasites live on annuals, or if on perennials they are confined to the leaves and are shed with them each year at leaf-fall (*e.g.*, *Phyllactinia* on hazel). Observations of several host plants, notably the hazel, have been made regularly since the autumn. The persistence of the fruit bodies containing spores on the fallen leaves, and the rate and methods of decay of these leaves, have been noted regularly from time to time. The significance of these and other observations cannot be fully appreciated until they have been extended over, at the very least, a period of twelve months. Meanwhile material of last year's leaves bearing fruit bodies has been stored with a view to studying the germination of the spores—and, if possible, the artificial infection of the hosts this spring. The mode of entry, the effect of the parasite on the host and the susceptibility of the host to the disease have also to be studied.

It is certain that, if information can be accumulated along all or even some of these lines, such a summary of a whole group of parasites,

as opposed to investigation of isolated members of widely different groups, will lead to knowledge of general interest and value concerning the whole nature of the phenomenon of parasitism.

Another investigation of the details of the life-history of a fungus isolated from a specimen of diseased cotton has been in progress and is now approaching completion.

During the whole of the period under consideration, cotton plants have been grown regularly at the Experimental Gardens. They have also been used by other departments for work which is being recorded elsewhere.

Received March, 1935.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

APART from the remarkable developments in financial affairs and in what might be called American trade politics, which are described by the writer elsewhere in this issue, the major developments in regard to the statistical position of cotton since our last issue have been in the direction of reduced estimates for some of the principal Outside Growths. Following the reduction of the Egyptian estimate in December, referred to in our January issue, the tendency of private estimates has been to reduce the probable crop still further, and the sharp decline in the ginnings up to December tended to confirm this view. The January and February figures, however, were much better.

Next came the Indian Government's first crop forecast in December, which again showed a small reduction of acreage on last year's revised figures for the same date, and a corresponding reduction of the crop to 4,555,000 bales, the average yield per acre being exactly the same as at the same stage in the two previous seasons—81 lbs. The figures used in our table of the Indian crop on p. 136 are those of the so-called " Final " forecast in February, which, however, are still to be revised by the Supplementary forecast in April. They show a further reduction of acreage to 23,407,000 and the crop to 4,318,000 bales, the average yield being reduced to 74 lbs. per acre, as the result of very abnormal weather in January, which included severe frost in certain provinces.

It will be noted that the figures of the allocation of the Indian crop between long and short staple are substantially different from those given in former issues. This is due to the fact that the Indian Central Cotton Committee has recently issued revised statistics of this distribution, in which the " Barsi and Nagar " and " Salem " crops are transferred from long to short staple. They also allocate small parts of the Broach crop to short staple and the C. P. Oomras crop to long staple, but as we are unable to apply this correction to the current season we have not given effect to it in previous seasons. The total amount involved, however, is not large.

At the same time estimates of the Russian crop are apparently

being scaled down and the figure has now been put as low as 1,500,000 bales. On the other hand, the high estimates of the Brazilian crop are still maintained, and, as will be seen from the table on page 136, the Sudan crop figures show a substantial improvement on last year. The total crop for the Gezira is now second only to the record of 1931.

But the developments on the consumption side have been equally important. In the table given on page 108 Garside's monthly figures of world's consumption are summarized up to the end of January, and it is therefore not necessary to repeat them here.

The details of the U.S. monthly consumption by varieties given on page 137 are of special interest because they show that even in America the consumption of their own cotton did not maintain the recovery of October, and the December figure was only higher than that of last year because at that time the industry was working under a 25 per cent. restriction of spindle activity. In January, however, new high figures were again recorded, the total being the highest since August, 1933, and the daily rate the highest since April, 1934.

It may be noted here that while the U.S. monthly statistics give no details with regard to Sea Island, the annual figures recently published show that the consumption of Sea Island last year was only 296 bales against the high figure of 914 in the year before.

In view of the small figures of consumption, it is rather surprising that the monthly figures of the world's carryover of American cotton which are given in the table on page 137 show such a favourable comparison with those of last year. The interest of these figures about this stage of the season is that the peak of the monthly statistics is normally at the end of December, but in exceptional years the peak is at the end of November and December shows a decline. That, however, had only happened three times since these figures were first published in 1912, and it is all the more remarkable that it should have happened again this year.

The result is that the monthly total of the carryover at the end of January shows a figure of nearly 2,000,000 bales less than a year ago. This fully confirms the prospective decline in the carryover at the end of the season which, on the figures of the crop and the estimated consumption, should show a decline at the end of the season of something over 2,000,000 bales. (See table on p. 110.) Garside's preliminary estimate of the complete carryover, including mill stocks outside of the U.S.A., shows a reduction in the mid-season total of 2,844,000 bales.

The tables of prices, both Spot and Futures, given on page 138, show several interesting developments since November. American futures had shown some recovery from the low point of October when in January/February the markets were for a time very much disturbed by the uncertainty over the Gold Clause test cases in America, but the long delay in announcing the decision had so largely discounted the effect that when the result proved unexpectedly favourable to the Government the reaction was comparatively slight and proved to be very short-lived.

In the meantime Egyptian, both Sakel and Uppers, had made a much more marked recovery, so that in the case of Uppers both December and January marked new high levels for the season. As regards Outside Growths generally, Tanguis was the only one which continued its relative decline during December and January, while West African, Brazilian, and East African rose slightly. The most striking increase, however, was in the case of Indian, which in February touched a new high point since November, 1933.

SUDAN CROP.

	1933–34.				1934–35.*			
	Area: Feddans	*Crop: Kantars*	*Yield per Feddan*	*400-lb. bales*	*Area: Feddans*	*Crop: Kantars*	*Yield per Feddan*	*400-lb. bales*
Sakel:								
Gezira (syndicate) ...	155,896	360,230	2·31	88,757	156,040			
,, (Kassala Cotton						700,000	3·99	171,500
Company) ...	18,976	49,730	2·61	12,184	19,143			
Tokar	37,700	22,620	0·60	5,285	31,681	48,000	1·52	11,760
Kassala (Gash Delta)	31,146	61,365	1·97	14,960	28,210	50,000	1·77	12,250
Others	5,447	17,406	3·20	4,246	6,843	24,700	3·61	6,052
	249,165	511,351	2·05	125,432	241,917	822,700	3·39	201,562
American:								
Irrigated	12,300	53,584	4·36	12,671	12,421	34,466	2·77	7,927
Rain-grown ...	59,414	86,800	1·46	19,522	96,916	133,174	1·37	30,630
Total	320,879	651,735	2·03	157,625	351,254	947,340	2·70	240,119

* Estimates only.

INDIAN CROP.

(000's *Omitted.*)

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34	1934-35*
Area (acres)...	25,922	23,812	23,722	22,483	23,739	23,407
Crop (Government estimate)						
400-lb. bales†	5,243	5,226	4,007	4,656	4,970	4,318
Average yield per acre (lbs.)	81	88	68	83	84	74
Staple ⅞ and above (bales)	1,428	1,271	1,343	1,396	1,505	
Per Cent. of Total ...	*27·2*	*24·3*	*33·4*	*30·0*	*30·3*	
Staple below ⅞ (bales) ...	3,815	3,953	2,682	3,260	3,465	
Per Cent. of Total ...	*72·8*	*75·7*	*66·6*	*70·0*	*69·7*	
Commercial Crop:						
Net exports (bales) ...	3,868	3,729	1,582	2,741	—	
Mill consumption ...	2,373	2,271	2,346	2,360	—	
Domestic consumption ...	750	750	750	750	—	
Total	6,991	6,750	4,678	5,851	—	
Per cent. on Government estimate	+33·3	+29·2	+16·7	+25·7	—	
Season's average spot price (Liverpool—pence per lb.)	6·39	4·02	4·32	4·84	4·52	
Per cent. on American ...	70·3	70·4	89·6	86·1	75·1	

* February forecast. † Final revised figures.

WORLD'S CARRYOVER OF *AMERICAN* COTTON.

(RUNNING BALES 000'S, EXCLUDING LINTERS IN U.S.A.)

End of	*Stock and Afloat.* U.K.	*Stock and Afloat.* Continent.	*Stock and Afloat.* Orient.	*U.S.A.* Mill Stocks.	*U.S.A.* Public Warehouses.	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.**
1929, July ...	442	563	—	932	923	2,860	1,197	4,332	275
1930, January ...	618	1,198	448	1,730	5,343	9,337	1,007	10,344	—
July ...	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
August ...	542	957	555	1,113	5,764	8,931	—	—	—
September	554	1,056	604	1,115	7,347	10,676	—	—	—
October ...	549	1,224	701	1,315	9,452	13,241	—	—	—
November	593	1,340	818	1,526	10,387	14,664	—	—	—
December	648	1,364	776	1,596	10,288	14,672	—	—	—
1934, January ...	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
February	614	1,325	730	1,605	8,609	12,883	—	—	—
March ...	588	1,217	686	1,600	7,819	16,908	—	—	—
April ...	559	1,098	611	1,533	7,064	10,865	—	—	—
May ...	491	940	584	1,366	6,529	9,919	—	—	—
June ...	432	841	663	1,272	5,944	9,152	—	—	—
July ...	405	734	590	1,172	5,526	8,427	1,132	10,509	950
August ...	370	649	545	1,025	5,785	8,374	—	—	—
September	340	668	535	1,002	7,575	10,120	—	—	—
October ...	339	696	697	1,088	9,344	12,164	—	—	—
November	332	680	713	1,246	9,760	12,731	—	—	—
December	345	682	760	1 253	9,605	12,645	—	—	—
1935, January ...	397	640	768	1,149	8,930	11,884	—	—	—
February	363	619	739						

* Included in total.

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(RUNNING BALES 000'S: "FOREIGN" IN EQUIVALENT 500-LB. BALES.)

1933–34.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
November ...	475·4	22·1	461·8	0·9	9·0	3·6	59·1
December ...	348·4	19·4	338·9	1·1	6·2	2·2	51·6
January ...	508·0	22·3	493·8	1·1	10·2	2·9	57·8
February ...	477·9	24·2	463·8	1·5	9·3	3·3	59·7
March ...	543·7	24·7	527·9	1·3	10·7	3·8	74·5
April ...	512·7	24·4	499·1	1·1	8·6	4·0	67·8
May ...	519·8	22·8	507·1	1·0	7·4	4·3	63·9
June ...	363·4	17·3	352·9	1·0	6·3	3·2	55·0
July ...	359·4	17·1	349·7	0·6	6·1	3·0	63·0
1934–35.							
August ...	420·9	18·3	409·4	0·8	7·8	2·9	61·2
September ...	296·0	15·0	289·3	0·3	4·5	1·9	54·7
October ...	520·3	22·9	506·6	0·9	10·4	2·5	57·4
November ...	477·1	22·2	465·1	0·8	8·5	2·7	51·4
December ...	413·5	21·8	403·5	0·8	6·8	2·5	52·1
January ...	546·8	24·0	534·3	0·9	8·7	2·9	61·8

HIGHEST AND LOWEST FUTURES PRICES.

1933–34.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
November	10·30	9·41	5·29	*4·78*	7·08	*6·52*	5·99	*5·44*
December	10·29	9·96	5·20	4·96	7·55	6·78	5·99	5·67
January ...	11·49	10·30	5·93	5·19	8·42	7·57	6·58	5·99
February	12·54	11·53	6·48	5·92	*9·25*	8·36	7·23	6·61
March ...	12·38	11·71	6·40	6·04	8·91	8·35	6·99	6·69
April ...	12·23	10·86	6·14	5·62	8·62	7·90	6·80	6·18
May ...	11·59	10·70	6·05	5·57	8·37	7·88	6·63	6·14
June ...	12·52	11·61	6·55	5·94	8·48	8·22	6·98	6·55
July ...	*13·35*	12·03	*6·97*	6·28	8·60	8·10	*7·31*	6·75
1934–35								
August ...	*13·84*	12·97	*7·23*	6·77	8·71	8·29	7·54	7·19
September	13·43	12·35	7·00	6·57	8·65	7·87	7·59	7·02
October ...	12·53	*11·96*	6·70	*6·43*	8·21	*7·65*	7·19	*6·74*
November	12·66	12·02	6·80	6·45	*8·85*	7·99	7·58	6·97
December	12·72	12·44	6·89	6·64	8·79	8·46	7·64	7·38
January ...	12·75	12·27	6·94	6·75	8·72	8·51	*7·75*	7·56
February	12·73	12·26	6·88	6·68	8·58	8·36	7·57	7·38

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1933–34.	*American (Middling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil Pernam (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
November	5·09	77·6	100·0	102·9	114·7	120·6	112·6	137·7
December	5·33	75·6	100·0	100·9	114·1	124·4	113·5	145·2
January ...	6·07	74·0	99·2	99·2	111·5	120·6	109·9	140·4
February	6·67	73·2	98·5	97·8	107·5	118·0	107·9	136·6
March ...	6·35	70·1	98·4	94·5	107·9	118·9	108·0	137·6
April ...	5·88	70·9	100·0	94·9	109·4	121·3	106·5	137·2
May ...	6·20	75·2	99·2	95·2	108·9	120·2	107·6	135·8
June ...	6·84	73·2	99·3	95·6	107·3	118·3	102·8	122·1
July ...	6·97	72·5	98·6	96·4	106·5	117·2	104·0	122·0
Season's average	6·02	75·1	99·5	98·8	110·8	121·4	110·3	133·7
1934–35.								
August ...	7·11	70·5	99·3	96·5	105·6	116·2	105·1	122·9
September	6·91	69·8	99·3	96·4	106·5	116·6	103·9	121·7
October ...	6·92	68·1	98·6	95·7	107·2	114·5	105·2	118·8
November	6·96	70·7	98·1	95·3	106·8	114·7	108·8	129·3
December	7·20	73·8	98·2	95·4	107·9	113·5	109·4	124·2
January ...	7·08	77·5	98·6	95·8	109·9	113·4	112·6	127·1
February	7·10	77·5	99·3	96·5	110·6	113·4	107·3	124·8

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

176. Report on Conditions and Prospects of United Kingdom Trade in India, 1933-34. By Sir Thomas Ainscough. (Issued by the Dept. of Overseas Trade.) *Cotton Exports.*—The strenuous efforts which are being made by the Lancashire Indian Cotton Committee, with the active co-operation of all sections of the Lancashire cotton industry, to promote the greater use of Indian cotton in Lancashire, are bearing abundant fruit. In 1932-33 Indian cotton represented 4 per cent. of Lancashire's total consumption from all sources, whereas in 1933-34 the figure had doubled at 8 per cent.

177. Lancashire Indian Cotton Committee. The first annual report of the Lancashire Indian Cotton Committee was issued on February 1. An introductory chapter explains how the Committee, with Sir Richard Jackson as Chairman, was set up in the autumn of 1932 by the President of the Board of Trade in pursuance of an undertaking given to the Government of India at the Ottawa Conference held in July of that year. The Committee was enlarged in 1934 following the return of the British Textile Mission, which visited India, under the Chairmanship of Sir William Clare Lees, to discuss matters of mutual interest with representatives of the Indian cotton industry, and to make representations to the Government of India. The report of this Mission stresses the desirability of a policy of economic reciprocity such as the Committee has set out to foster.

In a letter printed at the beginning of the report, the President of the Board of Trade expresses the Government's appreciation of the excellent work done by the Committee, and states that the report contains a most effective exposition of the problems connected with the greater use of Indian cotton in this country.

Chapter II. deals with the facts of the Indian cotton position. Commenting on the progress made in the consumption of Indian cotton in Lancashire, it states that imports in the 1933-34 season exceeded those for the previous season by 57 per cent., this increase being due in very great measure to the work of the Committee. The Committee is of opinion that the future of India as a producer of raw cotton cannot safely be left to be determined by the operation of the price factor alone, but that it depends to a very large extent on the degree to which successful endeavours can be made to organize and regularize agricultural production in India itself, and upon a considered and efficient commercial policy designed to meet the circumstances of the oversea as well as her home market.

The results of the Committee's efforts to popularise Indian cotton in Lancashire are discussed in Chapter III. The aim has been that every unit in the industry should be encouraged, other things being equal, to "prefer Indian." Lists have been drawn up of spinners making yarn from Indian cotton and of manufacturers weaving cloth containing yarn made from Indian cotton. By constant personal approaches and by practical demonstrations of the commercial and technical advantages of Indian cotton, the Committee has tried to extend these lists from week to week. The result has been that many firms who previously were averse to using Indian cotton have begun to use it and find it satisfactory. In addition, the Committee has organized displays at the British Textiles Exhibitions in 1934 and 1935, which have shown the wide range of products being made with technical success and commercial advantage from Indian cotton, and there can be no question that they have created a great impression on the minds of buyers throughout the trade. "The goodwill in

Indian cottons, which the work of the Committee is creating, bids fair to constitute an asset of lasting value."

An extensive account is given of the technical investigations which have been made respecting Indian cotton. The Committee at the outset recognized that its efforts in other directions would be in danger of proving ineffective after a time if spinners who loyally responded to the appeal to substitute Indian cottons encountered difficulties with which they could not cope on technical grounds. To obviate this danger the Committee has taken two important steps: in the first place, it has instituted an Advisory Panel to be at the service of spinners desiring advice on technical matters; and secondly, it has enlisted the co-operation of the Shirley Institute in carrying out investigations on a number of specific points arising in the processing of Indian cottons.

Another chapter deals with the work to be done in India. The Committee stresses the need for complementary efforts to be made in that country to lay a stable foundation for an increased off-take in Lancashire of Indian cotton. Owing to the relative smallness of the Lancashire market in the past as compared with the Indian home and Japanese markets, there has been little incentive to private enterprise in India to cater for it. It is now being increasingly realized, however, that any considerable increase in the absorption of Indian cottons by Lancashire is dependent primarily upon a high degree of regularity and reliability in the supplies available from season to season. The practice of mixing widely different varieties of Indian cotton is discussed, and the Committee suggests that the only remedy for this evil is such improvement in the measures in force in India as will prevent the practice being followed in ginning and pressing factories. Appreciation is expressed of the efforts of the Indian Central Cotton Committee to improve the position, and also of the endeavours that are being made to increase the production of new and improved types of cotton in different districts of India.

In the concluding section of the report the Committee makes some general observations on the Imperial economic policy which brought it into being and rendered the work so important and desirable. Finally, an appeal for "give and take" is made to those in this country and in India who are working along complementary lines towards the same goals.

The following appendices are included in the report: Statistical Tables and Charts; Spinners using Indian Cotton, and Yarns Produced; Manufacturers using Indian Cotton; List of Piecegoods, etc., made in Lancashire from Indian Cotton; Suppliers of Indian Raw Cotton, (*a*) in India, (*b*) in the United Kingdom.

The report is a document of great merit. Copies will be supplied free on request to the Secretary of the Committee, at the Royal Exchange, Manchester 2.

178. Indian Central Cotton Committee. We have received from the Publicity Officer the following notices:

Facilities for Training at the Technological Laboratory, Matunga, Bombay. Two students will be admitted for training in the elements of spinning and routine methods of testing cotton fibre and yarn. The course will normally last for six months, and a fee of Rs. 50 only will be charged for the full course.

Development of Cotton-Growing in Sind. Discusses briefly the important development of cotton cultivation in Sind, and the progress made by the various schemes financed for the purpose by the Indian Central Cotton Committee, as recorded in the Ann. Rpt. of the Dpt. of Agriculture, Sind, 1932-33.

Development of Cambodia Cotton in Coimbatore District. Summarizes the progress made since 1919.

Development of Cotton Cultivation in the Central Provinces. Deals with the

progressive expansion of the area under Verum cotton, and the practical achievements of research on cotton problems, financed by the Indian Central Cotton Committee, as recorded in the Ann. Rpt. of the Dept. of Agriculture, Central Provinces, 1933-34.

179. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS, 1934. By N. Ahmad. (*Tech. Bull. Ser. A., No.* 26, 1934, Ind. Cent. Cott. Comm.) The reports contain the results of tests on Standard cottons of the eleven seasons 1923-34. As in former years, the Agricultural details, Grader's report, Fibre-properties, Spinning tests, and Remarks are given for each of the sixteen varieties tested. This year two cottons, C.A.9 from United Provinces, and Hagari 25 from Madras Presidency, have been omitted, the former being no longer grown on a commercial scale, and the latter being replaced by Hagari 1. Ten of the cottons showed improvement over last year, while three gave the same and three gave poorer results. The varieties showing improvement were: Jayawant, 1027 ALF, Wagad 8, 289 F, C. 402, Verum (Nagpur), Umri Bani, Co. 2, Hagari 1, and Karunganni C. 7.

180. INDIAN INDUSTRIAL RESEARCH: ORGANIZATION. (*Naure*, **134**, 1934, p. 789. Abstr. from *Summ. of Curr. Lit.*, xiv., **24**, 1934, p. 685.) "Recent industrial developments in India are briefly discussed, and the necessity for scientific research as a basis for future industrial advance is pointed out. A recent conference adopted a proposal for the establishment at the Alipore Test House, Calcutta, of a Research Bureau under the general supervision of the Chief Controller of Stores, Indian Stores Department, the duties of which are to be mainly advisory. It is questionable whether such a bureau will be likely to stimulate research on a broad and fundamental basis. Conditions in India are, in many respects, very different from those pertaining elsewhere, and in a country where superabundant labour requires employment it seems essential that so far as possible small scale (cottage) industries should be encouraged. This is possibly intended to be the primary function of the proposed bureau. It is apparently anticipated that the larger industries will be in a position to provide their own research facilities, and that no direct encouragement or interference by the State is required. With the exception of the Indian Cotton Committee, no organization in India appears to be planning long-period research on fundamental problems. The formation in India of a Department of Scientific and Industrial Research on the lines of those in Great Britain and other countries is recommended."

181. BOMBAY COTTON ANNUAL, 1933-34, No. 15. (East Ind. Cott. Assen., Ltd., Bombay.) The usual authoritative compendium of all matters relating to every branch of the cotton trade. Contains statistical tables of crops, exports, imports, prices, stocks, consumption, Government notifications, etc., and is designed to meet the requirements of all those who are interested in the production, distribution, and consumption of Indian and foreign cottons, yarns, and cloth.

182. MADRAS: COTTON CULTIVATION, 1933-34. (*Rpt. on Operations of Dpt. of Agr.*, Madras, 1933-34.) The three new strains of Cambodia (Nos. 920, 1,267, and 1,742) which proved superior in yield to Co. 2 last year, were also successful this year. At Koilpatti, strain No. C. 7 is still the most popular variety, while two new strains, Nos. 2,681 and 2,682, are quite promising. At Nandyal three strains have been evolved which are up to the standard of N.14, giving a spinning value of 42's. Of these strains, No. 556 has on an average given the highest yield. At Guntur Station, where selection work is done on Coconadas, about 150 single

plant selections were under test with No. 171 as the standard. Strain No. 20 gave the highest yield of about 25 per cent. over the control.

183. Indian Cotton Flower Pigments: Composition. By T. R. Seshadri. (*Current Sci.*, 2, 1934, p. 343. Abstr. from *Summ. of Curr. Lit.*, xiv., 22, 1934, p. 610.) The Cambodia cotton flower is cream-coloured and contains quercimeritrin, the Uppam flower is bright yellow and contains gossipitrin, and the Karunganni flower is also bright yellow, but contains the two glucosides in equal amounts. The different colour of Cambodia, therefore, is not explained by the presence of a different glucoside, nor is it due to any special effect of metals or pH. The suggestion is made that the glucosides exist in the free state in Uppam and Karunganni, but the quercimeritrin in Cambodia is loosely combined with some other organic substance through the hydroxyl group in position 3.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

184. The following reports have recently been received:

Department of Scientific and Industrial Research: Rpt. for 1933-34.
Rothamsted Experimental Station: Rpt. for 1933.
British Guiana: Divisional Rpts. of Dpt. of Agr. for the year 1933.
Kenya Colony: Agricultural Census, 1934.
South Africa: Farming in S. Afr. Ann. Rpt. of Dpt. of Agr., 1933-34.
Queensland: Ann. Rpt. of Dpt. of Agr. and Stock, 1933-34.

185. Report of Department of Scientific and Industrial Research, 1933-34. (Cmd. 4,787. Pubd. H.M. Stat. Off., 1935, price 3s. net.) The nineteenth report contains the report of the Advisory Council and a general review of the work carried out under the supervision of the Boards and Committees of the Department, together with a section describing the work of Research Associations.

186. AFRICA. Kenya Colony: *Cotton Industry*, 1933-34. (*Agr. Census*, 1934.) The total quantity of seed cotton purchased amounted to 8,305,601 lb., the average prices paid in the Coast Province being 8·6 cts. per lb. for "A" quality and 3·9 cts. for "B" quality. In Nyanza Province the price for "A" quality was 10·3 cts. per lb., and for "B" quality 4·3 cts. per lb. The cotton was almost entirely of non-European cultivation.

187. Nigeria: *Cotton Investigations.* (*Bull. Imp. Inst.*, xxxii., 3, 1934, p. 458.) From a report by the Agricultural Chemist, Northern Provinces, covering the period January-June, 1934, we learn that two experiments on the manuring of cotton were carried out. In one, farmyard manure was tested against a dressing of rotted grass, with and without the addition of mineral manures to bring the latter to the same nitrogen, potash, and phosphate level as the farmyard manure. In the other case single and double dressings of farmyard manure were tested against a single dressing of farmyard manure plus a single dressing of artificials. The manurial effect of rotted grass, as has been found before, was nil, but in both experiments good results were obtained with artificial manures.

The Agricultural Botanist, Northern Provinces, states that Strain L, the Allen selection which is being multiplied up, did not do well in 1933. The season was unfavourable for cotton generally, but appeared to depress L more than the ordinary variety, particularly where soil and rainfall conditions were markedly different from Zaria, where the strain had been selected. In view of these results, distribution of L will be confined for the present to those districts which are similar in soil and rainfall conditions to Zaria.

In the report of the Botanical Section, Southern Provinces, it is stated that the yield of Improved Ishan A at Moor Plantation was considerably lower than those recorded for previous years. This was mainly due to the adverse weather conditions experienced. Three other Ishan strains, selected after crossing on the lint character as superior in this respect to Ishan A, were under field trials for the first time, but the results of the test suggest that none of them will ever be good enough to replace Ishan A, and further work on these cottons will be deferred for the present.

188. NYASALAND: *Cotton Cultivation*, 1934-35. A report from H.M. Eastern African Dependencies Trade and Information Office for the month of November states that "natives are showing great keenness in cotton planting, and seed issue accompanied by encouragement and careful instruction, is going on satisfactorily in all suitable areas."

189. *Cotton Industry*, 1933-34. (*Crown Colonist*, December, 1934, p. 584.) It is stated that "a favourable market has enabled the native growers to receive an average price of 1·1d. a pound for their cotton, and over £40,000 has been disbursed to them this season. The distribution of seed for 1935 has been largely increased, and it is hoped that the crop for next year will be doubled. Not only is expansion being aimed at in areas hitherto under cotton, but new areas are being opened up."

190. SOUTH AFRICA: *Cotton Cultivation*, 1933-34. (*Farmg. in S. Afr.*, ix., **105**, 1934, p. 477.) From this report we quote the following: "Owing to an improvement in the market a much larger area was placed under cotton during 1933 than during the previous year, and in spite of damage caused by floods along the Orange River, an increase is expected in the yield for the 1933-34 season. Prices have distinctly improved since the last planting season, being at present nearly 7d. per lb. This rise in price is, however, attributable mainly to a decrease in the area planted to cotton in the United States, and the serious drought by which the industry has been confronted in that country.

"It would appear that there are indications of a revival in the cotton industry, especially as there is a possibility of the improved price level being maintained for a further twelve months, which may induce cotton growers to extend the area planted, provided climatic and other conditions are favourable. A hopeful sign is that the quality of the cotton already gathered is much better than has been the case for the past three years."

The floods along the Orange River prevented the continuance of the cotton experimental work at Kakamas Station, but at the Barberton Station, under the control of the Empire Cotton Growing Corporation, cotton problems were intensively studied.

During the season enormous damage was caused to all crops in the Union by swarms of Red and Brown locusts, and in addition the cotton crop suffered injury from bollworm.

191. *Cotton Industry. Prospects for* 1934-35. (*Crops and Markets*, December, 1934.) Owing to the steadiness of the cotton market and the fair planting conditions generally, a larger acreage has been planted throughout all areas. Growing conditions to date have been good. Slight bollworm infestation in ratooned crops has been reported from the Eastern Transvaal, and a little damage to young crops by locusts in the Orange River area.

192. SUDAN: *Experimental Work in* 1932-33. *Section of Botany and Plant Pathology*. By R. E. Massey. (*Ann. Rpt. Gezira Agr. Res. Serv.*, 1933.) Exceptional rainfall experienced in the Gezira in June provided conditions favourable

to the persistence of ratoon growth from the stumps of cotton plants in the previous year's cotton land. The ratoons were in many cases already infected with leaf curl, and the presence of large numbers of white flies led to rapid infection of the new crop. The method of clearing the old crop by chopping at ground level was found inadequate, and a hand tool, by which the whole plant and root could be pulled up, was devised and tested by the Section. The principle was adopted by the Sudan Plantations Syndicate, who with a modified model of their own design disposed of the remains of the entire crop at the end of the season. A quantitative examination, made in conjunction with the Plant Observation Section, of healthy and leaf curl plants of the same age, size, and development indicated that the reduction of yield caused by leaf curl disease may amount to 50 per cent.

In connection with blackarm disease, it was ascertained that the amount of blackarm developing on the new season's cotton at the Gezira Research Farm between October 30 and November 9, 1932, was directly influenced by the position of the plot in relation to the previous year's cotton, the greatest infection being on land adjoining that on which cotton was grown the previous year, in which infected debris might be expected to occur. This infected debris can, under certain conditions, give rise to a heavy infection of new crop seedlings, but it has been found that flooding, where it can be efficiently carried out, is entirely effective in killing out the organism. When strips of cotton were sown in concentric arcs at increasing distances from badly infected cotton in an adjacent plot, the sector of the circle bordering the arcs being divided into two equal portions, in one of which the natural growth of weeds was left untouched, in the weeded sections the organism spread to a distance of 217 yards, whereas in the others it spread only 90 yards, the weeds evidently acting as barriers to spread. No seed-borne infection occurred in the Gezira wherever seed was sown which had been disinfected with Abavit B.

Other diseases encountered were *Fusarium solani*, which was isolated from the fine rootlets of wilting cotton, and *Macrophomina phaseoli*, which caused widespread seedling infection, but little eventual loss of crop.

193. Cotton Plant: Growth under Irrigation in the Sudan. By F. Crowther. (*Ann. Botany*, 48, **1034**, p. 877. Abstr. from *Summ. of Curr. Lit.*, xiv., **23**, 1934, p. 626.) An experiment is described on the effects of water and nitrogen supply on the development and physiological processes of the cotton plant grown under artificial irrigation in the Sudan. The results show the function of nitrogen in stimulating meristematic activity, and of water in extension growth. Net assimilation rate is unaffected by water or nitrogen supply during the main growth phase. The bolls are found to exert a dominating effect on the whole plant when their development begins, resulting in cessation of apical growth of the main stem and in the stoppage of nitrogen uptake from the soil, presumably through checking of root growth. The nitrogen supply to the plant as a whole is interrupted at the time of the most serious drain on the nitrogen reserves of the plant by the developing bolls. It is suggested that the cessation of root growth operates through interference with the carbohydrate supply to the roots.

194. Tanganyika. *Cotton Industry*, 1933-34. (*Crown Colonist*, December, 1934, p. 583.) In the Eastern Province, owing to excess of rain and lack of sunshine, the cotton crop has been a failure. Instead of the anticipated 17,000 bales, probably not more than 5,000 bales will be exported. On the other hand, Mwanza Province, which has suffered from a drought which caused an almost complete failure of the groundnut crop, has reaped a remarkable cotton crop.

Cotton stores overflowed, and mountains of raw cotton, sometimes 30 and 40 feet high, rose outside the stores, while thousands of natives lined up to sell their produce. Mwanza town ran completely out of money as a result of the unexpected demand, and more than £100,000 was distributed within a few days to the outlying districts. Motor vehicles of all descriptions travelled day and night in a desperate endeavour to relieve the congestion and move the crop before chance showers caused loss and damage. It is reported that the record number of 21,000 bales has been collected. This unexpected result during conditions of severe drought raises an interesting point for investigation in regard to conditions which may suit the crop.

195. UGANDA: *Cotton Prospects*, 1934-35. The report for January, recently received from the Dept. of Agriculture, states that in general the rains continued throughout December, and in Buganda and Busoga, where normal temperatures obtained, there was some improvement in crop prospects. East of the Nile, the extension of the rains was accompanied by cloudy weather and subnormal temperatures, which conditions retarded the growth and ripening of the crop. In the Eastern Province early buyings indicate that, as a result of adverse growing conditions, the grade of raw cotton will be below that of last year. At the end of December a total production of 250,000 bales was estimated.

196. *Cotton Industry*, 1934-35. From the March number of the *Crown Colonist* we quote the following: "Cotton buying is in full swing. The ginners have formed co-operative pools throughout the country for a period of five years, and this is generally accepted as a good move. The buying price is controlled by Government, who are endeavouring to assure that both the grower and the buyer obtain fair and economic prices. Raw cotton is being bought at Sh. 13.50 per 100 lb., which is about Sh. 3 more than was paid last year, while lint is about 58 cents per lb., which is 10 points higher than last year. Arrivals of cotton, however, are not very free, growers holding back and hoping for Sh. 15. A total crop of 250,000 bales is confidently expected. Cotton seed is quoted at Sh. 26 per ton f.o.r. Uganda stations, and at this price considerable business has been done. The whole crop will be exported at this price, which is Sh. 10 higher than last year. During 1934 cotton tax collected amounted to £110,189."

197. AUSTRALASIA. QUEENSLAND: *Cotton Cultivation*, 1933-34. (*Ann. Rpt. of Dpt. of Agr. and Stock*, 1933-34.) The outstanding experiences of the season were the record crop ginned and the progress made in developing supplies of seed of the varieties producing the medium staple cottons which are now required by Australian spinners. A total of 26,649,617 lb. of seed cotton was produced, which is approximately 46 per cent. greater than the previous record for the State—18,182,642 lb. in the 1924-25 season. Unfortunately, there was no corresponding improvement in the marketing of the crop. Mid-seasonal difficulties and uncertainties concerning cotton sales affected the financing of the first advances to the growers. On being given a definite assurance that the Federal fiscal policy relating to cotton would not be altered during the calendar year, the spinners agreed to take half the crop harvested. The tariff position is still uncertain, and the question whether the Australian spinning industry will develop further cannot yet be determined. Fiscal stabilization is a matter of first importance to farmers generally, for additional reliable cash crops, such as cotton, are required in the agricultural economy.

The standard of cultivation has improved steadily year by year. At the Callide Research Station reliable results were obtained from most of the experiments. As a result of the work in pure seed production sufficient seed of the

Durango variety will be available to meet all demands, and of Lone Star variety to plant 50,000 acres.

The principal pests encountered were the corn earworm (*Heliothis obsoleta*), rough bollworm (*Earias huegeli*), pink bollworm (*Platyedra gossypiella*), and the cutworm (*Euxoa radians*). Although pests and diseases caused considerable economic loss, they were not so widespread in their incidence as in former years.

198. WEST INDIES. SEA ISLAND COTTON INDUSTRY. (*The Vincentian*, 29/12/34.) The annual general meeting of the West Indian Sea Island Cotton Association was held in Montserrat in November, 1934, when delegates from most of the cotton-growing islands attended. Important matters dealing with the industry were discussed. The Advisory Committee in England of the Association have met at frequent intervals during the past nine months, and an outline of their work was given to the Association by a member of the Committee. Suggestions for the more effective control of pink bollworm were discussed by the Association, which also considered certain changes to the cotton seed control ordinance. The enforcement of this ordinance has contributed largely to the improvement in quality of the cotton produced in the Islands.

COTTON IN EGYPT.

199. COTTON PRODUCTION IN EGYPT. By P. K. Norris. (*Tech. Bull.*, *No.* 451, U.S. Dpt. Agr. Washington, D.C., 1934.) A very readable account of cotton cultivation in Egypt, giving a good general description of climatic conditions, soils, irrigation, population and labour supply, land tenure, crop rotations, costs, acreage and production, yields of different districts, factors influencing yields, pests, diseases, cotton varieties, Government action and policy, factors influencing future cotton production, etc., all illustrated with tables and photographs.

200. EGYPTIAN COTTON YEAR-BOOK, 1933-34. We have received from the Editor a copy of this publication. It contains complete information on the season's principal events and prospects for 1934-35, agricultural and cotton statistics for the past nine years, and the following among other short articles by specialists on trade and technical matters: "The Egyptian Cotton Variety Problem as Seen from Giza" (C. H. Brown); "The Possible Extension of Cotton Cultivation in Egypt" (H.E. Negib Bey Ibrahim); "Estimating the Egyptian Cotton Crop" (M. A. Sirry Eff.); "The Fungous and Bacterial Diseases of Cotton in Egypt" (T. Fahmy); "A Spinning Test Station in Egypt" (H. A. Hancock).

201. "EGYPTIAN SUPPLEMENT." (*Man. Guar. Coml.*, 11/1/35.) Contains much useful and interesting information regarding cotton matters, the financial position, Civil Service, education, banking, transport, irrigation, Government aid for agriculture, etc.

202. A PLAN OF CONTROL FOR EGYPTIAN COTTON: THE PROBLEM OF THE CONSUMPTION SIDE. By Col. B. H. Waters-Taylor and J. I. Craig. (*Egypt. Supplmt. Man. Guar. Coml.*, 11/1/35.) The creation of a Cotton Price Executive is suggested, and the functions of such a body are discussed.

203. EGYPTIAN COTTON: THE INDISPENSABLE MINIMUM. By G. Pilavachi. (*Egypt. Supplmt. Man. Guar. Coml.*, 11/1/35.) It is considered that the indispensable minimum of Egyptian cotton, without which the cotton industry could not get on, is 350,000 bales, mostly Sakel, Maarad, and Uppers.

204. Financing the Cotton Crop. By Sir E. Cook. (*Egypt. Supplmt. Man. Guar. Coml.*, 13/1/35.) Deals with the changes in the credit system.

205. The Progress of Cotton Research: Four Factors in Crop Control. By W. L. Balls. (*Egypt. Supplmt. Man. Guar. Coml.*, 11/1/35.) The author writes: "There are four controllable conditions whereby we are able to produce nowadays as big a crop from the flowers of June-July as our predecessors were able to make with all August, September, and part of October available to them in addition. These factors are closer spacing, sand sowing, early sowing, and early watering. The interesting thing about them is that when they are used in combination the cost of cultivation is scarcely increased at all, provided that the extra water is available."

206. The Future of Sakel. By H. Enan. (*Egypt. Supplmt. Man. Guar. Coml.*, 11/1/35.) The author is of opinion that Sakel will always be in demand, and that a quantity of 160,000 to 200,000 bales a year will always find a ready market. A price for Sakel equivalent to 20 to 30 per cent. over Uppers is considered to be the minimum margin to keep it profitable.

207. Egyptian Cottons: Characteristics. By G. A. Ela. (*Min. Agr. Egypt. Plant Breeding Section*, Leaflet No. 4, 1932. Abstr. from *Summ. of Curr. Lit.*, xiv., **21**, 1934, p. 563.) A short account of each of the existing commercial varieties of Egyptian cotton and the new strains produced by the Plant Breeding Section—viz., Ashmouni Gedid and Malaki, Zagora Malaki, Giza 3, 7, and 12, Nahda, Sakha 4 and 11, and Sakel Domains Gedid No. 310.

208. Egyptian Cotton: Effect of Chemicals on Colour. By —. Kazet. (*Spinn. u. Web.*, 52, **43**, 1934, p. 8. Abstr. from *Summ. of Curr. Lit.*, xiv., **22**, 1934, p. 603.) When Egyptian cotton is required in its natural colour the impurities should be removed by suitable washing treatments. Alkalis and soap-like agents affect the colouring matter in the raw cotton. On treatment with alkalis Egyptian cotton turns redder and sometimes acquires a violet tinge which does not change on subsequent washing. After-treatment with acids causes a change to an orange or yellowish shade. Formic and acetic acids are recommended for this treatment. The colours obtained in this way are perfectly fast to water.

209. Varieties of Egyptian Cotton. By I. S. Varuntsjan. (*Bull.* [*Trudy*] *Zaknihi Pop. Sci. Ser.* 29, 1933, p. 51. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 41.) After a brief discussion of the value of the Egyptian cottons and the history of their cultivation, the author refers to the work of the Soviet breeders in demonstrating the possibility of their acclimatization in the Soviet Union and the selection of strains suitable for cultivation there. Indications are given of the cultural measures necessary to grow these cottons, and then follows a botanical description of the Egyptian cottons as a group and of the main varieties individually.

210. Maarad Cotton: Cultivation in Egypt. Soc. Royale d'Agriculture, Cairo. (*Rapport du Conseil d'Administration*, 1932-33, presented 1934. Abstr. from *J. Text. Inst.*, xxv., **12**, 1934, A558.) Most of the research done in 1932-33 concerned the improvement of Maarad cotton with respect to wilt resistance and fibre qualities, the number of flowers per plant, and the effects of leaf removal on fruiting and maturity. A propaganda campaign for Maarad cotton has increased sales of seed and maintained prices. It is hoped to find a foreign market for the seed on account of the high oil content.

211. The Nature of Soil Deterioration in Egypt. By D. S. Gracie *et al.* (*Tech. and Sci. Serv. Bull. No.* 148, Min. of Agr. Egypt, 1934.) A preliminary

account of the causes and nature of the deterioration of fertile Egyptian soils. The subject is dealt with under the following heads: Types of Water Movement; Features of Basin Land; Description of Types of Infertile Soils; Interrelation of Types of Infertility; Classification of these Infertile Soils; Processes Involved in the Formation of Infertile Soils; Deterioration of Land in General; Effects of Soil Deterioration on Crop Yields; Necessity for Drainage; Prospects of Amelioration of Deteriorated Land.

The author states, in conclusion, that "throughout the country soil deterioration is undoubtedly coming to be associated in the public mind more and more with poor drainage conditions. The installation of an intensive drainage system should, however, be regarded as a purely preventive measure. It is advocated mainly from the point of view of the conservation of the fertility of fertile land and only secondarily from the point of view of the reformation of deteriorated land. A serious warning must be given that, even with good drainage, the amelioration of land already deteriorated may be disappointingly slow."

COTTON IN THE UNITED STATES.

212. THE AMERICAN COTTON INDUSTRY. By A. F. W. Coulson. (*Text. Wkly.*, xiv., Nos. 352/3, 1934.) A study of conditions in the American cotton textile industry prior to the formulation of the Code of Fair Competition, the effect of the code on the cotton industry's policies and organization, and the changes which have taken place under the code from July, 1933, to August, 1934.

213. THE AMERICAN COTTON INDUSTRY. By G. A. Sloan. (*Text. Wkly.*, xiv., **355,** 1934, p. 455.) The experiences of the first year under the Code, processing tax, etc., are discussed.

214. AMERICAN COTTON IN 1933-34. By G. W. Fooshe. (*World Textiles Supplement Man. Guar. Coml.*, 6/10/34.) A detailed discussion of recent events and present tendencies. The author states there is frank concern among some of the most able growers, shippers, and financiers in the South over the gradual contraction of foreign outlets for American cotton, and over the probable irretrievable loss of the supremacy of the South in cotton production if the present policies of the Administration of curtailing acreage and artificially maintaining prices are continued. It is pointed out that markets once lost are extremely difficult to regain, and that the South may be surrendering a priceless heritage for a mere mess of pottage in the form of temporary increase in farm income.

215. PROVIDENCE AND POLITICS. By C. T. Revere. (*World Textiles Supplement Man. Guar. Coml.*, 6/10/34.) A description of how the reduction of 4,000,000 bales in the new American crop has been brought about—more by the action of nature than by that of the Government of the United States. Owing to the action of the drought, Texas, which under the Bankhead Act should have declined to 3,237,000 bales, is only producing 2,383,000 bales.

216. AMERICAN *v.* OUTSIDE GROWTHS OF COTTON. By A. B. Cox. (*Int. Cott. Bull.*, xiii., **49,** 1934, p. 45.) A summary of the situation, in which the author points out that "foreign countries have increased acreage more than enough to offset the forced decrease in the United States," and is rather pessimistic as to the possibility of the United States regaining the markets lost.

217. PROCEEDINGS OF THE 38TH ANNUAL CONVENTION OF THE AMERICAN COTTON MANUFACTURERS' ASSOCIATION. (Pubd. by the Assen. at Charlotte, N. Car., U.S.A. Abstr. from *J. Text. Inst.*, xxv., **12,** 1934, p. 422.) The Convention was held at Charleston, South Carolina, in April last. The report contains two addresses of note: firstly, that by the retiring President of the Association,

T. M. Marchant, who dealt, among other matters, with the position of the cotton textile industry in the States, and who furnished a number of tables dealing with employment, wages, cost of living, etc., in the industry. The second outstanding address was that by G. A. Sloan, President of the Cotton Textile Institute, who dealt with the incidence and operation of the National Recovery Act, and more particularly in regard to its application in the cotton industry. The report of his address is illustrated with graphs of hourly wage rates, weekly earnings, employment, and cotton consumption over the period 1929-1934.

218. TEXTILES IN THE UNITED STATES. By W. Whittam. (*Text. Rec.*, lii., **621**, 1934, p. 60.) Deals with the reduction of the cotton surplus, the problems of the textile trades, and the costs of picking cotton. In connection with the last the author states that definite data have now been published for the first time by the Crop Reporting Board. Wage rates declined steadily from 1.25 and 1.27 dollars per 100 lb. seed cotton picked in 1924 and 1925 to 41 cents in 1931. From 1931 to November, 1934, wage rates increased to 60 cents per 100 lb. (Approximately 300 lb. seed cotton is equal to 100 lb. lint.) The lowest two years' averages of the eleven were, for the United States, 1931 at 41 cents, and 1932 at 42 cents. When it is borne in mind that for the average picker working from daylight to dark, 100 lb. seed cotton per day is a good average, it is not difficult to envisage the destitute condition of this huge proportion of agricultural workers.

219. WORLD TEXTILES: WITH A REVIEW OF AMERICAN COTTON. (Pubd. by *Man. Guar. Coml.*, October 6, 1934.) Contains, among others, interesting articles dealing with the American cotton crop 1933-34, cotton, rayon, silk, linen, and woollen fabrics, hosiery and lace novelties, and machinery developments.

220. THE EFFECT OF SHADE ON AMERICAN COTTON. By R. L. Knight. (*Empire Jour. of Exp. Agr.*, iii., **9**, 1935, p. 31.) The experiments were designed as a preliminary investigation to determine by means of artificial shades the effect of continual clouds on American cotton. In the first year's work an area shaded with coarse white cotton cloth is compared with an equal unshaded area. The second year's experiment deals with a triple comparison between a shade similar to the previous year's, a heavier shade composed of a double thickness of hessian, and an equal unshaded portion.

Shading with cotton cloth reduced the production of buds, flowers, and bolls, and also the shedding of these and of leaves. The incidence of blackarm was lessened. Yield was reduced by nearly two-thirds. Plant-height was increased and also the height of the first sympodium, and the lint produced was longer. Pest-incidence (bollworm, aphis, and jassid) was increased.

Under the double hessian shade, bud-production was very much further reduced, and flowering and bolling completely prevented. The development of buds in the lower region of the main stem was suppressed, so that the lowest sympodia were produced very high up the stem. Sympodia were extremely short, and there was a large reduction in plant-height and in the number of main-stem nodes. Leaf-shedding was greatly lessened and so was the incidence of blackarm. Diameters of stem and root were smaller, as was also the proportion of xylem to the other tissues in the stem. The roots were less lignified and rooting was not as deep as in the other treatments.

The conclusion is drawn that continued cloudiness may be a major factor in lowering the yield of cotton.

221. COTTON SEED BREEDING IN AMERICA. (*Int. Cott. Bull.*, xii., **48**, 1934, p. 457.) More than 1,200 different names of cotton varieties cultivated in America have been listed, about 400 of which have been added in the last ten years. Comparatively few varieties now cultivated have been subjected to any

selection or improvement that could properly be called breeding. During recent years superior high-yielding varieties of Upland cotton of $\frac{15}{16}$ to $1\frac{1}{4}$ inches staple, and longer, have been bred and developed by the U.S. Department of Agriculture, State Agricultural Colleges, and competent private breeders. In spite of the vigorous campaign to encourage wider planting of these superior varieties, only about 5 per cent. of the approximately 600,000 tons of seed required to plant the American crop comes from seed breeders, the remainder being largely mixed gin-run stocks producing a large proportion of short, irregular fibre with poor spinning quality.

222. Arizona: Cotton Cultivation. By C. J. King. (*U.S. Dpt. Agr. Tech. Bull.*, *No.* 392, 1933. Abstr. from *Summ. of Curr. Lit.*, xiv., **23**, 1934, p. 626.) An account is given of various structural modifications, and maladies commonly referred to as "crazy top," that are encountered in the irrigated cotton regions of Arizona, due to water stress often aggravated by the impervious character of the soil. The field may present the appearance of being sown to grossly mixed seed. Upland types are more affected than Pima.

223. Louisiana: *Field Crops Experiments.* (*La. Sta. Bien. Rpt.*, 1932-33. Abstr. from *Exp. Sta. Rec.*, 71, **4**, 1934, p. 463.) Gives the results of recent experiments including variety tests, breeding work, and fertilizer trials with cotton.

224. New Mexico: Cotton Spacing Experiments in the Mesilla Valley. By A. R. Leding and L. R. Lytton. (*New Mexico Sta. Bull.*, 219, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 623.) Spacing experiments with Acala cotton made in co-operation with the U.S. Department of Agriculture from 1929 to 1932, inclusive, provided for spacings of one plant to 12, 18, and 24 inches of row, 2 to 12 inches of row, blocked-out rows, and unthinned rows. Spacing of plants at medium distances, such as 1 or 2 plants to 12 inches of row, appeared most favourable for maximum early production and for large yields. Too close spacing tended to reduce the quantity of cotton at the first picking, and total yields usually were smaller than from medium spacings. Wide spacings, such as 18 and 24 inches, did not compare favourably either in first picking or total yields with 12-inch spacings. In total yield, and especially in the first pickings, the 12-inch spacings usually produced more than the blocked-out and the unthinned rows. Two plants every 12 inches seemed better than one every foot, and 12-inch rows better than 18-inch rows.

COTTON IN FOREIGN COUNTRIES.

225. Association Cotonnière Coloniale. *Bull. No.* 16 contains the announcement of the death of the Director-General of the Association, M. Édouard Hesling. The bulletin also contains the following articles: "La culture cotonnière en A.O.F." (Belime); "Rapport sur les travaux effectués par le Service Agronomique de l'Office du Niger pendant la campagne 1932-33," continued from *Bull. Nos.* 14 and 15; "Utilisation du coton pour des usages autres que la filature" (Dantzer). Notes on cotton in the French Colonies, cotton legislation, etc., are also included.

Bull. No. 17 contains the following papers: "Rapport sur les travaux effectués par le Service Agronomique de l'Office du Niger pendant la campagne 1933-34"; "Une conférence de M. Belime" (Nelson-Uhry); "La production cotonnière de l'A.O.F." (Simon); "Le coton au Soudan Anglo-Egyptien" (Fontanier); "Développements agricoles récents au Congo Belge" (Leplae). The usual notes on cotton in the French Colonies, cotton legislation, etc., are included.

226. Brazilian Cotton: Classification and Exports. (*Indus. Text.*, iii., **32**, 1934, p. 48. Abstr. from *Summ. of Curr. Lit.*, xiv., **21**, 1934, p. 553.) Statistics are given for the exports of cotton from Sao Paulo since January 1, 1934, classified according to countries, together with details of the classification according to standard types and to staple during the month of July, 1934.

227. Development in China. (*Int. Cott. Bull.*, xii., **48**, 1934, p. 554.) A report by Dr. Rajchman, technical adviser of the Council of the League of Nations, on his mission to China. It is stated that if China becomes an industrial nation, cotton weaving and spinning will probably be the most important of its industries. At present the industry is more heavily capitalized and employs more labour than any other of the growing industries. Eleven provinces are suitable for cotton growing, Shansi, Honan, Hopei, Shantung, and Kiangsu being the best areas. The supply of cotton, however, is inadequate for the spindles of the present cotton industry. In 1932 the import of raw cotton totalled $233 million, amounting to more than a quarter of China's visible adverse balance of trade. The industry needs at least 12 million piculs (picul=133⅓ lb.) per annum, and with the increase in demand for cotton goods which must be anticipated with an increase in the prosperity of the farmer, this need will continually become greater. The reason for this unsatisfactory state of affairs is due partly to the low productivity per acre of Chinese cotton-growing districts, and partly to the poor quality of the seed used.

228. China: Plans for Assisting Cotton-Growing. (*Int. Cott. Bull.*, xiii., **49**, 1934, p. 25.) With a view to facilitating rehabilitation of the cotton industry, it is learned that the Cotton Control Committee of the National Economic Council, with the assistance of several leading Chinese banks, is organizing a Cotton Production and Sales Co-operative Society, which will have branches in various cotton-producing centres throughout the country. The aim of the new society, it is learnt, will be to extend loans to cotton-growers. Funds will be allotted to facilitate the various processes of cotton production in the following proportions: Purchase of seed and fertilizers, $50,000; ginning and packing, $20,000; transportation and sale, $200,000. Loans for the purchase of seeds and fertilizers will be redeemed by paying the society in cotton harvested each season; loans for ginning and packing are to be redeemed in five years; loans for transportation and sales are to be redeemed after the products are sold.

229. Germany: Utilization of American Cotton in. By T. Klingg. (*Wirtschaftsdienst*, 19, 1934, p. 1397. Abstr. from *Summ. of Curr. Lit.*, xiv., **20**, 1934, p. 551.) A brief history of the utilization of American cotton in Europe since 1784. The advantages of synthetic textile fibres for Germany are pointed out, as this would ensure independence of manufacture and regularity of supply.

230. Greece: Cotton Cultivation. (*Int. Rev. Agr.* Rome, xxv., **11**, 1934, p. 887.) The efforts made by the Government towards an expansion in cotton cultivation are beginning to meet with success. As a result of the propaganda of the Cotton Institute cotton was grown in new areas last year. The use by growers of selected seed and cleaning implements, and an improvement in the irrigation system, have contributed to an increase in the unit yield. A considerable increase in yield is expected in the present season.

231. Japan's Cotton Industry. By A. S. Pearse. (*Int. Cott. Bull.*, xiii., **49**, 1934, p. 109.) An interesting account of a third visit. Some of the causes of Japan's success are said to be: low operative costs, low overhead charges, good organizations for sale, and the spirit of co-operation existing between employers and employees.

232. Japan's Present-Day Industry. By F. K. Abe. (*Ind. Text. Jour.*, xlv., **529**, 1934, p. 14.) A review, from a Japanese standpoint, of the year 1933, dealing with exports, exploitation of new markets, plans for self-supply of raw materials, rationalization of management, reduction of costs of production, etc.

233. The Cotton Trade in Japan. By P. L. Taylor. (*Text. Wkly.*, xiv., **355**, 1934, p. 467.) Traces the history of Japan during the past sixty years, and surveys the present conditions in the cotton industry.

234. Japanese Textile Industry: Development and Working Conditions. By J. J. Dollfus. (*Bull. Soc. Ind. Mulhouse*, 100, 1934, p. 453. Abstr. from *Summ. of Curr. Lit.*, xiv., **22**, 1934, p. 625.) Contradictory reports on industrial working conditions in Japan are briefly discussed, and the subject is studied from an historical point of view. Employers' and operatives' organizations and industrial legislation are discussed, and an account is given of the present working conditions, particularly those in the textile industry. It is pointed out that the success of the Japanese industry is due not merely to low wages and long hours of work, but also to the use of efficient modern methods and to a high degree of organization.

235. Peru. We have received from the Department of Overseas Trade a copy of the *Rpt. on Econ. Condns. in Peru*, dated August, 1934. (Darrell Wilson.) The quality of the 1933 crop was good as regards cleanliness and colour, but the spinning quality was less than that of previous years, and the most widely grown variety, Tanguis, has deteriorated during the past few years. Other varieties cultivated were Pima, Smooth Perus, Mitafafi, Rough, and Mid Rough.

The crop prospects for 1934 were generally good. One feature of the crop preparation was that most farmers cut down the old roots and planted first-year cotton on their lands. The bulk of the farmers obtain loans from the Banco Agricola del Peru, which was established for the purpose in 1931, and which is the farmers' main source of supply of funds. The Bank performs its work in a thoroughly satisfactory manner, and is one of the most efficient institutions of its kind in South America.

236. Peru: Origen del Algodon Tanguis. By R. Ferrero. (*La Vida Agricola*, ix., **108**, 1932, p. 653.) In 1930 54,624 tons of cotton were exported from Peru, more than four-fifths being Tanguis cotton. At the beginning of this century disease was a factor in cotton growth that prevented its successful prosecution. Fernim Tanguis identified the disease as due to *Fusarium vasinfectum*, and started out to obtain an immune variety of cotton. After three years of investigation he found a plant that was immune upon the hacienda of Zarate, and its descendants comprised two types: one, three carpelled, with small and naked seed and roughish broad fibre, the other with four to five carpels, small seeds with fuzz, and soft and broad fibre, and both immune. The following year the second type did not prove entirely wilt resistant, and was abandoned. The first was multiplied and selection work was carried out, and the product, at first sold as Egyptian, was soon known as Tanguis. The author then gives considerable detail regarding the origin, structure, and other characters of the cotton, and the paper is furnished with several illustrations and diagrams. To those who have to do with Tanguis cotton and can read Spanish, the article should prove of much interest.

237. The Cotton Industry in Persia. (*Int. Cott. Bull.*, xiii., **49**, 1934, p. 127.) An interesting article describing the recent development of the cotton spinning and weaving industry.

238. RUSSIA: COTTON CULTIVATION. By G. Rothenburg. (*Wirtschaftsdienst*, 19, 1934, p. 1471. Abstr. from *Summ. of Curr. Lit.*, xiv., **22**, 1934, p. 582.) Cotton cultivation in the chief agricultural region of the great plain of Azerbaijan now occupies 191,200 hectares and extends into Georgia in the steppes of Eldar and Karajask. The autonomous republic of Nachitschewan and the part of Armenia south-west of Eriwan also form an important cotton-growing region. The type of cotton planted is chiefly American Upland. Last year 26,000 hectares were devoted to the cultivation of Egyptian cotton in Azerbaijan. The home production of this type of cotton is now sufficient for the limited requirements of the Russian textile industry, and the Russian organization for the purchase of Egyptian cotton in Alexandria has now been abolished. In 1933 the Transcaucasian cotton production amounted to 147,000 tons compared with 126,000 tons in 1932. The production in Central Asia was 810,000 tons, but it is doubtful whether the combined crops will be sufficient to meet Russian requirements. Cotton cultivation could be extended by the appropriation of land now used for the cultivation of wheat—*e.g.*, in Azerbaijan—and by the development of new regions by irrigation. The application of artificial manures to increase yields is recommended. Mechanization in cotton cultivation in these districts is only just beginning, but there are about 2,000 tractors in Azerbaijan.

239. RUSSIA, AGRICULTURAL PROGRESS IN. (*Socialist Plant Industry*, Ser. A., No. 10, 1934 [in Russian]. Abstr. from *Bull. Imp. Inst.*, xxxii., **3**, 1934, p. 433.) *Cotton.* The amount of cotton produced in 1934 was 80 per cent. greater than that obtained in 1913. Although it was considered impossible for cotton to be grown in the Northern Caucasus and Southern Ukraine, yet in 1934 the area under cultivation in those regions amounted to 350,000 hectares.

240. PROGRESS IN COTTON GROWING IN U.S.S.R. (*Int. Cott. Bull.*, xiii., **49**, 1934, p. 36.) From the fifth place in the world cotton production, which Russia occupied before the war, the country has risen to the third place, and when the work at present in hand is completed the U.S.S.R. should assume second place.

241. SOVIET SCIENTIFIC PLANT INDUSTRY DURING THE PERIOD OF SOVIET RECONSTRUCTION, 1930-33. By N. I. Vavilov. (*Bull. Appl. Bot. Leningrad*, 1934, Ser. A 10, p. 5. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 18.) The achievements of the last three years are reviewed, reference being made to the enormous scale on which agricultural research is now carried on in the U.S.S.R. As a result of this it is now possible for every locality to cultivate only those varieties that are adapted to it. The State Variety Testing Service is testing over 2,000 Soviet and foreign varieties of 125 different crops at 400 different stations. Breeding methods are being fundamentally changed so as to form a complex system involving the co-operation of physiologists, phytopathologists, entomologists, chemists, and technologists.

242. BOTANICAL AND ECONOMICAL CHARACTERISTICS OF COTTON VARIETIES BRED AT ZAKNIHI (TRANSCAUCASIA). By E. Ryshkov and E. Mazo. (*Transcauc. Cot. Res. Inst.* (*ZakNIHI*), 1933, No. 37, p. 126. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 41.) A bulletin giving morphological descriptions and illustrations of the new lines of cotton selected by ZakNIHI, and of certain standard forms, with very brief indications of the agronomic characteristics (which are to form the subject of a separate work) and of the lint qualities. The varieties are divided into six groups according to time of maturity. Indications are also given of correlations existing between certain morphological characters and degree of earliness.

243. QUALITY OF SOVIET COTTON FROM NEWLY SELECTED VARIETIES: NEW VARIETIES AND SPECIES OF COTTON AND THEIR UTILIZATION. Pt. I. By V. V.

Laikov. (Publications N.I.T.I., Moscow, 1932, pp. 80-117. From *Plant Breeding Abstracts*, v., 1, 1934, p. 42.) Studies were made of the spinning qualities of a number of the best improved cotton varieties grown in the U.S.S.R. First the Lower Egyptian cottons of the Pima type are considered, various samples of each variety grown under different conditions being compared one with the other. The Upper Egyptian types are next considered, including Ashmouni and similar cottons, followed by the Uplands, then the varieties with medium staple, considered in order of their earliness. The observations show that by transplanting it is possible to grow high quality Egyptian varieties in the region of Tashkent, Pima selections spinning as high as 120 counts. For spinning 50's and 60's the long-stapled Uplands are as good as the Egyptians, and are from the cultivator's point of view superior. The variety Triumph Navrotskii was variable but spun 40's, and so still deserves attention. The spinning data for the different varieties in 1928 and 1929 are tabulated.

SOILS AND MANURES.

244. Rothamsted Experimental Station. The Report for 1933 deals among other matters with the work of the year in connection with field experiments, farm husbandry problems, physical and chemical properties of the soil, soil micro-organisms, plant pathology, entomology, insecticides, etc. During the year 81 papers were published in various scientific journals, and summaries of 55 of these are included.

In view of the great expansion of the work of the Soil Bureau, the adjoining farm and manor house were purchased in May last in readiness for the time when further accommodation would be required. The whole estate comprised 527 acres, and the purchase money, £34,000, was raised by public subscription.

245. Preservation of Soils against Degeneration. By W. L. Powers. (*Soil Sci.*, 37, **5**, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 602.) The author of this contribution from the Oregon Experiment Station reports upon a study of certain chemical characteristics of soil samples collected from some of the oldest experimental plats of Oregon, Ohio, Illinois, and Missouri. The long-continued use of manure, crop rotation with legumes, or liming in the case of acid soils, was found to be associated with a definite increase in total nitrogen, soil organic matter, and exchangeable base content.

246. Soil Crusts: Methods of Study, their Strength, and a Method of Overcoming their Injury to Cotton Stand. By A. Carnes. (*Agr. Eng.*, 15, **5**, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 707.) Studies conducted at the Alabama Experiment Station are reported. Soils varying in clay and sand content were used, and artificial crusts simulating those produced by natural rainfall were produced in the laboratory. An apparatus was developed to measure the breaking strength of the crusts that were produced. A section of crust was removed, measured, and supported on two knife edges a known distance apart, L. A weight was then let down gradually on the section of crust half-way between the supports. The weight was suspended by the spring of a Jolly balance. When the section of crust broke, the amount of the take-up in the spring indicated the weight, P, required to break the crust. From these measurements and determinations the modulus of rupture was calculated. The standard modulus used is the value of R in the formula $R=\frac{3PL}{2bd^2}$, in which b is the width of the crust section and d is its thickness.

It was found that crusts very similar to those found in field soils could be produced in the laboratory by sprinkling soil with large drops of water. The

crusts appeared to be produced by the infiltration of colloids and later cementation of soil particles.

The amount of crust formed on a given soil was found to vary with the amount of rain. It appears for the soils with the least hydrated colloids, such as Cecil, Sumpter, and Houston, that the relationship between rainfall and the force of breaking for each soil follows a general law whose form is $R = ae^{bx}$, when R is the modulus of rupture, a the intercept constant, b the slope constant, and x the amount of rain in inches. R is proportional to the surface in contact, which is a function of pore space. The formula states that the rate at which the pore space fills up under the action of water is proportional to the pore spaces.

The rate of drying was found to affect the breaking strength of the crust. A slow rate of drying produces a crust slightly harder to break. The breaking strength of crust formed under a given condition was found to bear an inverse relationship, within the range studied, to the amount of moisture in the crust at the time of breaking. The chemical nature of the soil affects the breaking strength of crust. The modulus of rupture of the crust of soils studied is greater in cotton middles than on ridges. Preliminary tests indicate that the injury to cotton stands caused by crust formation can be solved by the proper preparation of the seed bed before and at the time of planting. Planting cotton on a compacted seed bed affords a firm footing for the young plant in breaking through the crust, and results in a more efficient use of moisture present in the soil.

247. SOIL DYNAMICS. By A. Demolon. (*La Dynamique du Sol.* Paris: Dunod, 1932. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 593.) Following a brief historical retrospect and a definition of the soil, with the author's views as to the delimitation of the field of soil science, this treatise is divided into three parts dealing, respectively, with physical, chemical, and biological phases.

Part I. contains chapters on general concepts concerning the parent rock, the genesis and morphological classifications of soils, the general properties of disperse systems, the mineral and the humic colloids of the soil, mechanical analysis of the soils, internal structure of soils and their porosity, relation between soils and water, and the soil and radiant energy. Part II. similarly deals with soil reaction, the absorbing power of soils, the soil solution, and the so-called assimilable elements of the soil. Part III. takes up the movement of the soil population, the biochemical evolution of carbon in the soil, the biochemical evolution of nitrogen, and the concept of fertility. An appendix deals with methods of soil analysis.

248. OSMOTIC PRESSURE IN SOIL BACTERIAL CELLS AS RELATED TO THEIR CLIMATIC ADAPTATION CAPACITY. (Trans. title.) By E. N. Mishustin and M. A. Messineva. (*Mikrobiologiia*, ii., No. 1, 1933. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 597.) The observations recorded showed that bacterial cells separated from osmotic pressures increased from the moist to the drier regions, the pressure measured in the microbial cells found in the podsolic zone (Moscow, Archangel, etc.) not exceeding four atmospheres. As the sampling progressed southward the value steadily increased, reaching the maximum figure found—that of from fifteen to seventeen atmospheres—only at the southernmost point of observation (Krasnodar). This increase in osmotic pressure is considered a unique adaptation reaction of bacteria subjected to conditions unfavourable with respect to soil moisture content.

249. THE SPECIFIC INFLUENCE OF ACIDITY ON THE MECHANISM OF NITROGEN FIXATION BY AZOTOBACTER. By D. Burk *et al.* (*J. Bact.*, xxvii., **4**, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 598.) The authors of this contribution from the Bureau of Chemistry and Soils, U.S.D.A., find the rate of consumption

of free nitrogen gas by *Azotobacter* to decrease from a maximum at pH 7·8 to a zero limit at 6·0 (5·97 ± 0·02). The nitrogen-fixing enzyme system is termed "azotase." Its known properties are described. The particular enzyme of the system which combines directly with free nitrogen is termed "nitrogenase."

250. ABSENCE OR INACTIVITY OF AZOTOBACTER IN THE SOIL. By E. Dianova and A. Voroshilova. (*Mikrobiologiia*, ii., **2**, 1933, Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 598.) By a close comparison of the results yielded by various methods, the authors reached the conclusion that their failure to demonstrate the presence of *Azotobacter* in early fallow soil could not be due to inadequacy of the methods, but must indicate the actual absence of *Azotobacter* from this soil. Five years' field work gave the same results with respect to the early fallow soils as did the laboratory work. *Azotobacter* inoculated into limed field soils was still alive after five years, but in unlimed soils the numbers were very greatly reduced after eighteen months. The authors consider also that they have evidence of the existence in soils of an organism morphologically similar to *Azotobacter*, but having nothing else in common with it. This last-named organism is believed to have led to errors as to the presence of *Azotobacter* in early fallow and in some other soils.

251. THE PART PLAYED BY MICRO-ORGANISMS IN THE PROCESS OF HUMUS FORMATION. By A. B. Sorokina and M. G. Tiagny-Riadno. (*Mikrobiologiia*, ii., **3**, 1933. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 601.) The process of the formation of humus from dead tissue of *Aspergillus niger* was investigated. According to the authors' English summary: "*A. niger* possesses a great capacity for producing a synthesis of the α- and β-fractions of the soil organic matter from dead bodies of their own species. The cellulose-destroying bacteria, *Actinomyces flavus* and *B. mycoides*, have a great capacity for mineralizing the α-fraction in the humification of the fungus mycelium. In the case of infection with the soil suspension a particularly active formation of a humus at the expense of the dead mycelium of the fungus was observed. An alkaline reaction of the medium heightens the mineralizing capacity of the micro-organisms studied, whilst an acid one, on the contrary, increases their synthetizing activity. Fertilizers ($CaCN_2$ and superphosphate) have no influence upon the formation of humus, but they contribute to its mineralization by the micro-organisms. The most active formation of humus at the expense of the dead body of the fungus is observed in grey earth. In the artificial soil mentioned above the formation of humus is less intense than in grey earth, and under pH 8 the α-fraction is entirely mineralized. On Czapek's liquid medium, though the dead mycelium of the fungus is entirely mineralized, there is no accumulation of humus at all."

252. PHOSPHATE FIXATION AND PENETRATION IN SOILS. By A. F. Heck. (*Soil Sci.*, 37, **5**, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 606.) A contribution from the Wisconsin Experiment Station. Of the soils studied, the slightly acid Miami silt loam, with little active iron or aluminium, gave maximum penetration, whereas the laterites, with large amounts of active iron and aluminium, allowed very little penetration, the phosphorus being fixed and held largely in difficultly available forms within a few millimetres of the point of application.

253. ON THE NATURE OF REACTIONS RESPONSIBLE FOR SOIL ACIDITY—III. By J. Mukherjee, *et al.* (*Ind. J. Agr. Sci.*, iv., **4**, 1934, p. 733.)

254. SOIL ORGANISMS AND CROPS: REVOLUTIONARY DISCOVERIES. By Sir E. J. Russell. (*Times Trade and Eng. Number*, November, 1934, p. 8.) A

valuable review by a great authority, dealing with the activities of micro-organisms, fixation of nitrogen, the growth of lucerne, preparation of manure from waste vegetable matter, the need of phosphates in South Africa, Canada, and America.

255. Cotton Plant: Effect of Fertilizers. By D. A. Sabinin, *et al.* (*Proc. U.S.S.R. Sci. Res. Inst. Cott. Cult. and Ind.*, 37, 1931. Abstr. from *Summ. of Curr. Lit.*, xiv., **20**, 1934, p. 526.) High applications of N retard germination, flowering, boll-formation, and ripening, but additions of superphosphate counteract this effect.

256. Cotton Plant: Effects of Fertilizers. (1) By D. V. Kharkov and L. N. Pershakova. (2) By O. F. Tueva. (*Fertilizers for Cotton, U.S.S.R.*, 1933, Part I., pp. 37 and 48. Abstr. from *Summ. of Curr. Lit.*, xiv., **20**, 1934, p. 526.) Potassium alone extends the flowering period. It is effective on the yield primarily in combination with nitrogenous and phosphatic fertilizers. It increases the total leaf surface when applied in moderate amounts, but heavy applications have the reverse effect. The higher the ratio of P_2O_5 to N, the earlier do flowering and ripening begin; N alone retards ripening.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

257. Field Experimentation: the Modern Technique. By J. Wishart. (*Agr. Proc.*, **11**, 1934, p. 149. Abstr. from *Plant Breeding Abstracts*, v., **1**, 1934, p. 3.) A lecture delivered at the summer meeting of the Agricultural Educational Association at Cambridge in 1933. The modern technique, based on the application of statistical methods, and of the analysis of variance in particular, is described and illustrated.

258. Statistics in Agricultural Research. By J. Wishart. (*J. R. Stat. Soc.*, 1, 1934, p. 26. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 1.) In an introductory historical commentary the author traces the evolution of field experiments from the single plot technique as introduced by Sir John Lawes at Rothamsted in 1839 to the complex replicated layouts of today. The mathematical laws and methods, on which the statistical reduction of the data depends, are then set out, and by means of a simple example of an agricultural experiment on two types of seed drill, it is demonstrated how the analysis of variance technique, as introduced by R. A. Fisher, simplifies the problem of analyzing the data and testing the significance. The flexibility of the technique is further exemplified in the randomized blocks, Latin square, and more complex layouts. The theory of the analysis of covariance, a more recent development, is then described, and by means of illustrations from actual experiments its use as a valuable statistical tool is proved. Statistical methods are next applicable to the problem of sampling, and an exposition of a few cases in which one is compelled to sample, as an alternative to handling the entire bulk of the experimental material, shows the importance of the problem. Finally, statistical methods may be of great use in determining the effect of various weather factors on crops, where long records of yields and comparable meteorological data have been kept. Although the samples are agricultural in nature, the author throughout attempts to show by implication how the statistical methods described may equally wel be applied in other types of experimentation.

259. The Method of "Covariance" Applicable to the Utilization (the Previous Crop Records for Judging the Improved Precision of Expei ments. By M. Vaidyanathan. (*Ind. J. Agr. Sc.*, **4**, 1934. From *Plant Bre, ing Abstracts*, v., **1**, 1934, p. 1.) The possibility of improving the design o

increasing the precision of new experiments on the basis of preliminary yields is discussed. A combination of the method of "equalizing plot yields," and R. A. Fisher's randomized block layout in preliminary trials, seems to give considerable guidance in the design of new experiments. An efficient statistical method of actually adjusting experimental yields on the basis of preliminary yields is then provided by the "analysis of covariance" technique. Comprehensive tables are constructed to demonstrate all stages of the calculations, and the gain in precision by the use of this method is shown in an example.

260. NEW COTTON PICKER. (*Int. Cott. Bull.*, xiii., **49**, 1934, p. 97.) This machine is the invention of J. and M. Rust, of Memphis. It has a rapidly rotating smooth steel spindle that is moistened as it enters the open boll. The moistened spindle has no hooks or claws; it twists the cotton out of the bolls.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

261. ENTOMOLOGY WITH SPECIAL REFERENCE TO ITS ECOLOGICAL ASPECTS. By J. W. Folsom, revised by R. A. Wardle. (P. Blakiston's Son and Co., Philadelphia, 1934. Reviewed in *J. Econ. Ent.*, xxvii., **5**, 1934, p. 106.) In this review by E. J. Felt it is stated that the work has been thoroughly revised and brought down to date. The thirty-two pages of classified bibliography bring together an immense number of the more important citations relating to the various subjects discussed in the text.

262. TECHNIQUE OF FIELD EXPERIMENTATION IN ENTOMOLOGY. I. SOME PRINCIPLES INVOLVED IN A WELL-PLANNED EXPERIMENT. By L. L. Huber and J. P. Sleesman. (*J. Econ. Ent.*, xxvii., **6**, 1934, p. 1166.) A brief summary of some of the more important concepts which the economic entomologist should constantly keep in mind.

263. A BIBLIOGRAPHY ON THE USE OF AIRPLANES IN INSECT CONTROL FROM 1922 TO 1933. Compiled by W. E. McBath. (*U.S. Dpt. Agr. Bur. Ent.*, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **4**, 1934, p. 507.) This is an annotated compilation of the literature relating to the use of airplanes in control work with insects.

264. A MANUAL OF ENTOMOLOGICAL EQUIPMENT AND METHODS—I. By A. Peterson. (Edward Brothers, Ann Arbor, Michigan, 1934. Reviewed in *J. Econ. Ent.*, 27, **5**, 1934, p. 1106.) From this review by E. P. Felt we quote the following: "The author has brought within the confines of a lithoprinted work an account of much of the equipment or tools of the entomologist used in research work upon living insects. There is a brief discussion of field insectaries, illustrations with explanations of numerous insect cages and containers, a similar treatment of collecting, killing, sampling, and sorting equipment, of insect traps, and of the more technical apparatus, such as weather-recording instruments, thermocouples, thermostats, and also of devices for humidity control, evaporation measurement, cabinets for controlled conditions, and similar equipment. There are, in addition, tabulations of conversion temperatures, relative humidities, dew-point temperatures, pressures of aqueous vapours, and conversions for metric and U.S. customary measures and weights. There is an excellent index."

65. MACHINERY FOR DUSTING COTTON. By R. C. Gaines and D. A. Isler. *Fmrs'. Bull. U.S. Dpt. Agr. No.* 1729, Washington, D.C. 1934. Abstr. from *v. App. Ent.*, xxii., **11**, 1934, p. 652.) Brief descriptions are given of various pes of machines (showing their adaptability to different requirements) for in the United States in applying calcium arsenate dust to cotton against the l-weevil. The chief advantage that aeroplanes have over ground machinery

is that they render possible the treatment of fields immediately after heavy or prolonged rains, when the weevils may be causing serious damage. Experience has proved that their use is not more costly.

266. Sun-Heat Treatment of Cotton Seed as a Prevention against Pink Bollworm. By M. H. Khan. (*Seasonal Notes*, xii., **2**, 1934. Punjab Agr. Serv.) Suggests one day's exposure of cotton seed, in thin layers, to the direct rays of the sun on a very hot day in order to kill resting larvæ of pink bollworm.

267. La Lutte Biologique et son Importance Économique au Congo Belge. By H. J. Bredo. (*Bull. Agr. du Congo Belge*, xxv., **1**, 1934, Bruxelles. Abstr. from *Int. Rev. Agr.*, xxv., **10**, 1934, Rome, p. 230.) The author deals mainly with the parasites of *Platyedra gossypiella*, *Stephanoderes hampei*, *S. subvestitus*, and *Sylepta derogata*, which he proposes to multiply in the Bambesa Entomological Laboratory.

268. The Cotton Leaf-Roller and its Control. By M. A. Husain. (*Seasonal Notes*, xii., **2**, 1934, Punjab Agr. Service.) In 1933 known only as a sporadic minor pest, Leaf-roller became serious in 1934. The author recommends that all cotton refuse be burnt; only desi cotton should be grown in affected areas for the next two years; alternative food-plants should be destroyed; and when the pest is present in large numbers, dusting of the cotton plants with one part sodium fluosilicate or Paris green mixed with eight parts of ashes or road dust.

269. The Cotton Worm (*Prodenia litura*) in Egypt. By I. Bishara. (Pubd. Min. of Agr., Egypt. Abstr. from *Int. Cott. Bull.*, xiii., **49**, 1934, p. 60.) Discusses the life history and habits of the pest, the nature and extent of the damage caused, and the measures adopted to control it. The damage done to the Egyptian cotton crop has assumed much greater importance during the last few years, especially in the northern portion of the Delta, owing to the higher humidity in that district. The pest is kept under control by picking, but only by more or less compulsory labour and an army of Government inspectors to enforce it. The slightest relaxation of this control means that some peasants neglect to pick the eggs, and serious damage results. Poisons have not proved very efficacious. There is, however, one check which is of interest. It is known that the first generation of the worm on cotton mostly comes from *berseem* (Egyptian clover), and a law prohibiting the watering of *berseem* after May 10 has long been in existence, the view being that if the *berseem* be dried up by this date there will be no continuity of green food for the worm. Unfortunately, this law has been more honoured in the breach than in the observance, but the authorities have now fully realized its importance, and stronger action to enforce it has been taken during the current season.

270. The Locust Fungus: Further Observations. By A. McMartin. (*S. Afr. Sugar Jour.*, xviii., **6**, 1934, p. 329. Abstr. from *Rev. App. Mycol.*, xiii., **11**, 1934, p. 699.) The natural occurrence of *Empusa grylli* on the redwing locust (*Locusta migratoria migratorioides*) is stated to be widespread and of increasing intensity throughout the cane belt of Natal. In the normal course the external growth of the fungus appears shortly after death between the abdominal segments; in one case examined locusts dying about 5 p.m. showed an extensive external development by 11 p.m. Fungal growth continues as long as damp conditions are maintained, until finally the insect disintegrates. The pale yellow conidia of the fungus are produced in such numbers as to give a glistening, powdery aspect to the surface of the growth, whence they are shot off and adhere to any object on which they fall. In order to obtain a profusion of conidia a dry atmosphere is required; dried locusts killed by the fungus are covered with the yellow powder in such quantity that it may be scraped off with

a knife, while the leaves to which the insects cling also bear masses of the conidial dust. Conidial germination is dependent on moisture, but it is not known how the living insects become infected. So far, the results of inoculation experiments under controlled conditions are inconclusive, and research is considerably hampered by the lack of artificial cultivation of the fungus. The redwing locust appeared in Natal in 1894, to be followed a year later by *E. grylli*; in 1899 and 1900 both the insect and its natural enemy were present. There is no doubt that the fungus does act as a check on the locusts, but the full extent of its utility in this field cannot yet be determined.

271. Manual for the Locust Record Service. By G. Y. Bei-Bienko. (In Russian.) (*Ass. Contr. Pests Dis. Agric.* For U.S.S.R. Record Serv., Leningrad, 1932, price 3 rub. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., **11**, 1934, p. 614.) The Locust Record Service of the Russian Union has three principal aims in view: To study the relation between fluctuations of the Acridid population and ecological conditions, in order to be able to forecast outbreaks; to supply control organizations with data on the extent of infested areas and the best times for control measures; and to collect statistics of losses caused by Acridids and of the cost of control. The necessary information is obtained through correspondents at general observation posts on insect pests, and at special locust observation posts.

272. A Forecast of the Outbreak of Locusts in China. By P. Tsai. (In Chinese, with English summary.) (*Ent. and Phytopath.*, ii., **23**, 1934. Hanchow, China. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., **11**, 1934, p. 660.) Outbreaks of locusts in China appear to occur chiefly after dry, warm winters. Their occurrence is connected with the periodicity of the weather, which is itself related to sunspots. For this reason, outbreaks of *Schistocerca gregaria*, Forsk., in Egypt, Palestine, Persia, and Northern India, and of *Locusta migratoria*, L., in Central and North China occurred in 1927 and following years. Drought and high temperatures during May-July stimulate the development and reproduction of *Locusta* in China, and an outbreak was therefore anticipated in the autumn of 1934.

273. Locusts in Nigeria. By F. D. Golding. (*Trop. Agriculture*, xi., **12**, 1934, p. 308.) An interesting account of the bionomics of the various species of locusts in Nigeria, and of the means of control employed during the last four years. Four species have been recorded in Nigeria: the Migratory locust (*Locusta migratoria migratorioides*), the Red locust (*Nomadacris septemfasciata*), the Desert locust (*Schistocerca gregaria*), and the Tree locust (*Anacridium mœstum melanorhodon*). Of these the Migratory locust was the only pest of major importance.

274. On the Ecology of Acrididæ near Lake Chad. (*Bull. Ent. Res.*, xxv., **2**, 1934, p. 263. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., **11**, 1934, p. 619.) As the Nigerian shore of Lake Chad was suspected of being an area from which outbreaks of *Locusta migratoria migratorioides*, R. and F., and *Nomadacris septemfasciata*, Serv., originate, a preliminary survey was made in 1931, and in 1933 ecological research on these two species and about sixty other Acridids was carried out at Kalkala at the south-west corner of the lake. The agricultural and climatic conditions in the Kalkala area, as well as the vegetation, soils, fauna, and micro-climate of the habitats frequented by Acridids are described, and some observations on the hydrography of Lake Chad are included. Notes are given on the bionomics and ecology of most of the Acridids observed. The occurrence of *Anacridium mœstum*, Serv., was found to depend on that of small trees of *Acacia* and *Zizyphus*.

275. THE CONTROL OF NOXIOUS ACRIDIDÆ. By G. Y. Bei-Bienko. (In Russian.) (Moscow, Ogiz, 1934, price 1 rub. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., **11**, 1934, p. 614.) A concise account is given of the bionomics and ecology of Acridids, the organization of campaigns against them, and the usual methods of control, as well as of agricultural practices intended to reduce their breeding places. The more injurious species occurring in the Russian Union are briefly described.

276. NOXIOUS ACRIDIDÆ OCCURRING IN NON-IRRIGATED LANDS IN CENTRAL ASIA, AND THEIR CONTROL. By E. Ivanov and A. Spasskii. (In Russian.) (Moscow, Saogiz, 1934, price 1 rub. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., **11**, 1934, p. 614.) Natural conditions in the vast non-irrigated areas of Russian Central Asia, which are only partly cultivated, are favourable to the permanent occurrence of a number of Acridids, including *Dociostaurus maroccanus*, Thnb., *D. kraussi*, Ing., *D. plotnikovi*, Uv., *Ramburiella turcomana*, F.W., and *Calliptamus* spp. Numerous data on the ecology of each species are given. Poisoned baits are considered most suitable for the control of all except *R. turcomana*, which does not eat them, and should be dealt with by spraying. The technique of preparing and using baits is described in great detail.

277. CONSIDERAZIONI ENTOMOLOGISCHE SULLA COLTURA DELLE PIANTE DA FIBRA NELLA SOMALIA ITALIANA. By A. Chiaromonte. (*L'Agricoltura Coloniale* xxviii., **4**, 1934, p. 193.) A continuation of a previous article published in 1930 on the culture of cotton in Italian Somaliland. It deals principally with *Dysdercus cardinalis* and several other pests, and the extent of the injury caused to cotton.

[*Cf.* Abstr. **606**, Vol. VIII. of this Review.]

278. A COMPARISON OF THE LIFE CYCLES OF *Frankliniella tritici* (FITCH), *F. fusca* (HINDS), AND *Thrips tabaci*, LIND., (*Thysanoptera-thripidæ*) IN SOUTH CAROLINA. By J. G. Watts. (*J. Econ. Ent.*, 27, **6**, 1934, p. 1158.) Life history studies of the three species were made at the same time and under identical conditions during the five months from May to October, 1932. It is shown that the incubation period for *F. fusca* is more than twice that of *F. tritici*, and significantly more than that of *T. tabaci*. This point has considerable bearing when the application of an insecticidal control is involved in an association of the three species. It will be seen, therefore, that in order for a given application of an insecticide to be most effective against all three species, it should of necessity be applied at a time when the two latter species are in the second larval stage and the former species in the first stage.

A comparison of the life histories of the three species shows that *F. fusca* has the longest life cycle, lays the largest number of eggs per female, and lives the longest in the adult stage. *F. tritici* has the shortest life cycle, lays the least number of eggs per female, but in the adult stage lives slightly longer than *T. tabaci*.

279. CONTRIBUTION TO A KNOWLEDGE OF THE WHITE FLIES (ALEURODIDÆ) OF EGYPT—III. By R. Priesner and M. Hosny. (*Tech. and Sci. Serv. Bull., No.* 125, Min. of Agr., Egypt, 1934.) Seven species are discussed, but none has yet been observed on cotton.

280. SUDAN: *Cotton Pests*, 1932-33. By J. W. Cowland. (*Ann. Rpt. Gezira Agr. Res. Serv.*, 1933, received 1934.) From the report of the Gezira Entomological Section we learn that the chief pests causing injury to cotton during the season were White Flies, Thrips, the American, Egyptian, and Pink Bollworms, and the Cotton Stem-borer. The season was also notable for the great increase

in several species of Pentatomid bugs: *Agonoscelis versicolor*, F., *Callidea natalense*, and *Bagrada hilaris*.

An experiment was conducted in which white flies, previously infected with the leaf curl virus, were fed for one to nine days on the immune lubia or on clean Sakel plants, and then transferred to healthy Sakel seedlings. Successful transmission of leaf curl resulted for all the periods of 'clean feeding' tested, provided that not less than 50 to 100 white flies were used. Experimental evidence was obtained that cotton plants are not viruliferous earlier than one day before the appearance of definite vein thickening. Cotton was found to be susceptible to leaf curl at all stages, but in older plants development of the disease is considerably delayed, or does not occur until secondary growth begins. A study of the differential resistance of cotton and related plants to infection derived from different sources was carried out by transmitting the leaf curl virus by means of large numbers of white flies taken from the susceptible Giza 7 variety, Gezira Main Crop cotton, the resistant variety XH1029, *Hibiscus esculentus*, *H. cannabinus*, and Weika (an annual variety of *H. esculentus*) to each of these plants. The results showed clearly that XH1029 maintained its resistance no matter what source of infection was employed, that when itself infected it is much less capable of passing on its infection to other hosts than any of the other plants tried except *H. esculentus*, that *H. esculentus* only feebly transmits leaf curl, and that *H. cannabinus* is very susceptible and transmits the disease very readily.

281. Leaf Curl of Cotton in Southern Nigeria. We have been asked by Mr. F. D. Golding, Senior Entomologist, Nigeria, to publish the following note: "The unidentified Aleurodid mentioned in a paper by Golding entitled, 'A Vector of Leaf Curl of Cotton in Southern Nigeria' (Vol. VII., No. 2 of this Review) has proved to be new to science, and has been named *Bemisia goldingi*, Corbett. The Dolichopodid predator mentioned in the same paper has been identified as *Chrysosoma ernestum*, Curran, by the Imperial Institute of Entomology."

282. Report on the Third Imperial Mycological Conference, 1934. (Pubd. by The Imp. Mycol. Institute, Kew, Surrey, 1934, price 2s. net.) Among the subjects discussed at the Conference were the following: The Work and Organization of the Imperial Mycological Institute; Administrative Measures against Plant Diseases; Virus Diseases; Breeding and Selection for Immunity against Disease (*e.g.*, in potato, cotton, tropical crops); Cotton Diseases.

In connection with cotton diseases, Mr. Massey (Sudan) gave an account of the control of leaf curl in the Sudan, and also dealt with a seasonal deterioration of the cotton crop associated with root-rot and wilt. Mr. Hansford (Uganda) communicated a paper on the breeding of cotton and other crops for resistance against disease, and Dr. Fahmy (Egypt) reviewed the work which had been done in Egypt on breeding for immunity from cotton wilt.

283. Soil Deficiencies and Plant Diseases. By G. V. Jacks and H. Scherbatoff. (*Tech. Comm. No.* 31, *Imp. Bur. of Soil Sci.*, 1934.) Deals with deficiency diseases associated with the specific elements: manganese, iron, magnesium, boron, sulphur, copper, and zinc. In the preface the authors write as follows: "This Technical Communication on what is partly a physiological subject is entirely non-critical. Problems of plant deficiency diseases raise numerous physiological questions which we have only introduced when they directly affect the relation of the soil to the plant. On soil questions we have left the authors of the original papers to speak for themselves, and the occasional remarks which cannot be referred to published literature are expressed in the subjunctive mood. The literature of the subject is vast, and the possibility of our having omitted some important papers or points of view cannot be overlooked. We have, how-

ever, collected together what have seemed to us to be the most relevant facts in the several hundred papers we have scanned. We have included fairly detailed descriptions of symptoms, and trust that these may sometimes be found useful in the diagnosis and treatment of diseases of doubtful origin. The Technical Communication is not a textbook, but is intended rather as a guide to the original literature, which should be consulted whenever possible. The bibliography (367 names) is arranged alphabetically according to authors, and contains many entries not referred to in the text. It is preceded by a table in which all the papers in the bibliography referring to a particular deficiency of a particular crop are given. The table is thus a concise index to the literature of different deficiency diseases."

284. INDIA: *Cotton Diseases in the Central Provinces.* By F. J. Plymen. (*Rpt. on Working of Dpt. of Agr. Central Provinces*, 1932-33. Abstr. from *Rev. App. Mycol.*, xiii., **11**, 1934, p. 683.) The following references of phytopathological interest occur in this report. The seedling blight of cotton caused by *Rhizoctonia bataticola* (*Macrophomina phaseoli*) was found in 1931-32 to be more severe in late than in normally germinating seedlings, and also in fields where the crop was sown early in dry soil. Anthracnose (*Colletotrichum indicum*) caused heavy damage on early bolls and on the lint and seed of the first picking. *Gossypium* (*neglectum*) *Verum* 262 proved more susceptible both to seedling blight and anthracnose than *G.* (*n*) *roseum*, and in 1932-33 the latter outyielded the former on the Akola farm by 23 per cent. on account of its superior resistance to these diseases.

285. *Memnoniella echinatum* MOULD FUNGUS: ISOLATION FROM COTTON YARN. By L. D. Galloway. (*Trans. Brit. Mycol. Soc.*, 18, Pt. II., 1933, p. 163. Abstr. from *J. Text. Inst.*, xxv., **12**, 1934, A584.) An unusual mildew with rather square black spores has been isolated from a crop of yarn heavily infected with *Stachybotrys*. It is designated *Memnoniella echinata*.

286. COMPARING SOIL FUNGICIDES WITH SPECIAL REFERENCE TO PHYMATOTRICHUM ROOT-ROT. By W. N. Ezekiel and J. J. Taubenhaus. (*Sci.*, N.S., lxxix., **2061**, 1934, p. 595. Abstr. from *Rev. App. Mycol.*, xiii., **11**, 1934, p. 698.) Of a number of volatile chemicals recently tested in the laboratory for their toxicity to the root-rot fungus (*Phymatotrichum omnivorum*) in Texas, pentachlorethane, tetrachlorethane, and xylene proved the most effective. In a preliminary field test, tetrachlorethane placed in the soil at a depth of six inches destroyed the fungus on cotton roots to depths of at least 2 feet.

287. EFFECT OF FERTILIZERS ON THE YIELD OF COTTON AND ON THE CONTROL OF THE ROOT-ROT DISEASE OF COTTON ON THE BLACKLAND PRAIRIE SOILS OF TEXAS. By E. B. Reynolds and H. E. Rea. (*J. Amer. Soc. Agron.*, xxvi., **4**, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **4**, 1934, p. 468.) Numerous fertilizer experiments with cotton showed that 4-8-4, 4-8-0, and 6-12-0 fertilizers produced significant but not profitable increases in yield of cotton. The fertilizer treatments had no effect on the root-rot disease (*Phymatotrichum omnivorum*).

288. MORPHOLOGY AND LIFE HISTORY OF THE COTTON ROOT-ROT FUNGUS IN TEXAS. By D. C. Neal, *et al.* (*J. Agr. Res.*, 49, **6**, 1934, p. 539.) Studies of the morphology of the ozonium and sclerotial stages of the cotton root-rot fungus, *Phymatotrichum omnivorum*, are reported, together with information bearing upon the life cycle of the fungus in the infested districts of Texas. The hyphæ involved in the growth and development of the fungus are described, as well as the type concerned in the penetration of the host tissues. Comparisons are given of the structure of the strands and sclerotia at various stages of their development. Studies of the strands included histological preparations of subterranean strands, strands obtained from soil cultures, and strands underlying

conidial mats. The cellular structure of both young and old strands, as shown in longitudinal and cross sections, was found to be quite diverse. The central portion was in some cases well defined, comprising from 1 to 3 large septate hyphæ, while in others the strands were entirely cellular, revealing in general the morphology of true sclerotia. The sclerotial character of the strands shows that they function not only to spread the fungus vegetatively, but also to maintain it in a viable condition during prolonged periods of inactivity. In this respect, they are analogous to the rhizomorphs of certain Basidiomycetes.

Histological studies of mature and newly formed sclerotia obtained both from laboratory cultures and from the soil have largely confirmed the work of other investigators. In examinations of sections of young sclerotia it was found that the large central hypha extends through the sclerotium, and that it is largely as a result of the branching and division of these cells that the sclerotia are formed. The gross morphology and cellular structure of some of the sclerotia found in the infested districts of Texas are described.

The importance of the strands in the overwintering of the disease is further shown by the numerous positive tests of their viability under varying conditions, especially those from fallow plots, from areas planted to non-susceptible crops, and from soil cultures after prolonged intervals. The ability of these strands to produce infection was further demonstrated by pure culture isolations and inoculation experiments. The importance of the sclerotial stage of the fungus in the perpetuation of the disease in the soil is also discussed, and additional information given regarding the occurrence of this stage in nature. The article is well illustrated, and a list of literature is given.

289. ATTACK OF CELLULOSE BY *Stereum purpureum*. By L. Latz. (*C. r. Acad. Sci.*, 199, 1934, p. 893. Abstr. from *Summ. of Curr. Lit.*, xiv., **23**, 1934, p. 650.) Attack of cotton fibres by *Stereum purpureum* in a culture medium suitable for Hymenomycetes results in hydrolysis by the following stages: cellulose, hydrocellulose, cellulose coloured red by iodine (erythrocellulose), cellulose coloured yellow by iodine (xanthocellulose), insoluble gums, intermediate substance between gums and sugars, cellobiose, and glucose + fructose. The various stages are distinguished by staining tests and other simple reactions.

GENERAL BOTANY, BREEDING, ETC.

290. TWO CASES OF LINKAGE IN NEW WORLD COTTONS. By S. C. Harland. (*Trop. Agriculture*, xi., **12**, 1934, p. 316.) During the past eight years much information has been obtained respecting the hereditary behaviour of characters in New World cottons. About thirty factors at eighteen different loci have been established to exhibit simple monohybrid inheritance, and the linkage relationships of most of the loci have been studied. Practically all genes exhibited free association, but two cases of relatively close linkage have been encountered. In view of the large number of chromosomes ($n=26$) in New World cottons it seems desirable to place the facts with regard to these on record.

Linkage between Green Lint G^l and Crinkled c^r.—As previously pointed out by the writer and by Ware, green and white lint form an allelomorphic pair of characters in Upland cottons (*G. hirsutum*, L.), and may be represented as $G^l - g^l$. The type known as "Crinkled Dwarf" occurs rather frequently as a mutant in Sea Island, *G. barbadense*, L., and has been recorded also in Egyptian cotton under the name "Wrinkled Leaf." In crosses with Upland cotton Crinkled Dwarf exhibited blending inheritance. By repeated back-crossing of heterozygotes to Upland, the type of segregation ultimately resolved itself into one of simple monohybrid relationship, and it became possible to investigate the linkage relationships of the crinkled gene (c^r) to known Upland genes. Crinkled proved to be linked with green lint as follows:

TABLE I.

Linkage relationship between Green lint and Crinkled in the back-cross $(G^lC^r \times g^lc^r) \times g^lc^r$.

Normal Green.	Normal White.	Crinkled Green.	Crinkled White.
80	7	1	71

Cross-overs=5 per cent.

The genes for green lint and crinkled are thus about five units apart on the chromosome.

Linkage between Red R^1 and Cluster Habit c^1.—Thadani found a linkage between the red coloration of certain types of Upland and the cluster habit. In F_2 of the cross Red Cluster by green normal he obtained the following numbers:

Red Normal.	Red Cluster.	Green Normal.	Green Cluster.
136	48	73	0

It will be seen that no cross-overs appeared in Thadani's experiments. The writer has studied a cross in which linkage and not repulsion is expected. The results are as follows:

TABLE II.

Linkage relationship between Red and Cluster in the back-cross $[RC^1$ (red normal) $\times rc^1$ (green cluster)$] \times rc^1$ (green cluster).

Red Normal.	Red Cluster.	Green Normal.	Green Cluster.
231	36	39	234

Cross-overs=13·9 per cent.

Discussion.—Hitherto, although it has proved possible to transfer single genes from Upland to Sea Island-Egyptian and *vice versa*, the prospects of synthesising, for example, a type of Upland with Egyptian quality lint have appeared somewhat remote. The genetical make-up of the two species *G. hirsutum* (Upland) and *G. barbadense* (Sea Island-Egyptian) is apparently so different that crosses between them result in mutual disintegration of the co-ordinated systems of modifier complexes which have become different in the two species through long continued geographical isolation. As more cases of relatively close linkage are discovered in the New World group it will become possible to transfer definite chromosome sections from one species to another, and much important information of economic value may result. Will, for example, the transference from Upland to Egyptian or *vice versa*, of the thirteen unit section between Red and Cluster, result in the simultaneous transference of any genes of economic importance? Experiments on these lines will form the subject of future investigations.

291. INVESTIGATION OF DISTANT HYBRIDIZATION OF PLANTS IN THE U.S.S.R. By G. D. Karpechenko. (*Bull. Appl. Bot.*, Ser. A., **10**, p. 41, Leningrad, 1934. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 12.) The great possibilities, and also the difficulties, of the method of distant hybridization are briefly touched upon, and mention is made of various methods whereby these difficulties may be overcome.

In regard to cotton it is stated that "intensive efforts are now being made to effect the duplication of the chromosomes artificially by the use of an improved form of the callus method, abnormal temperatures, and various narcotics, etc.

Among the cottons under experiment are hybrids of *Gossypium hirsutum* × *G. barbadense*. Crossing with a third species constitutes a further method, and if the third species has double the chromosome number of the hybrid, and the latter forms unreduced gametes, triple hybrids may be formed which are stable cytologically, but genetically heterozygous."

292. The Duration of the Favourable Influence of Alfalfa on the Cotton Fields of Armenia. By K. P. Mirimanian. (*J. Amer. Soc. Agron.*, **26**, **6**, 1934. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 622.) During four years of uninterrupted cultivation to cotton following prolonged cropping to alfalfa, the soil underwent many changes. In the first year (1929) of cotton cultivation—*i.e.*, just after alfalfa was ploughed under—the humus, total nitrogen, and exchangeable calcium increased noticeably, accompanied by a slight increase of moisture-holding capacity and total porosity. From this point on, however, these values decreased slowly with a rather sharp decline by 1932. Favourable conditions created in the soil by prolonged cultivation to alfalfa were conserved during the first three years of cotton, but began to disappear in the fourth year of continuous cotton. The yield of cotton was in harmony with the changes in the soil. The 6 per cent. increase in yield in 1930 was explained partly by a surplus of nitrogen from the decomposition of the alfalfa. Under conditions prevailing in the Echmiadzin district of Armenia the favourable influence of alfalfa seems to persist for three years, but begins to decline from then on.

293. The Occurrence of a Type of Female Sterility in Cotton. By R. K. Iyengar. (*Madras Agr. J.*, **22**, 1934, p. 152. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 5.) In a *Herbaceum* strain No. 1281 certain plants were observed which, though healthy, vigorous, without any malformations of the vegetative parts, and producing many flowers, developed no bolls. The flowers as a rule never opened. Though the stamens were normal the staminal column was stunted, with a large number of free filaments; the pollen was normal, and there was no anther sterility, but the normal club-shaped stigma standing out from the staminal column was absent, and dissection showed that the ovary was present, but the style was much shortened with a thin flattened stigma at the top.

294. Accuracy of the Percentage of Lint Cotton Determined on Small Laboratory Gins. By J. T. Vantine. (*J. Amer. Soc. Agron.*, 26, **6**, **1934**. Abstr. from *Exp. Sta. Rec.*, 71, **5**, 1934, p. 623.) When twenty 10-lb. samples from a thoroughly mixed lot of Startex 582 seed cotton were ginned at the Texas Experiment Station on a 20-saw gin, and fifty 200-g. samples and fifty 50-g. samples of the same lot on an 8-saw gin, the error in percentage of lint of these samples was small. One representative sample carefully handled was enough for a reliable determination of lint percentage, so that the size of sample is not so important if a representative sample is used. Correction for differences between the different sizes of samples used probably is not warranted.

295. Cotton Plant: Resistance to Cold. By V. I. Tzivinskii. (*C. r. Acad. Sci. U.S.S.R.*, i., 1934, p. 147. Abstr. from *Summ. of Curr. Lit.*, xiv., **20**, **1934**, p. 540.) Within a group the resistance to frost of different species is proportional to the concentration of the cell sap.

296. Estimation of the Number of Fibres on a Cotton Seed by Different Methods: A Comparison. By R. L. N. Iyengar. (*Ind. J. of Agr. Sci.*, iv., **5**, **1934**, p. 906.) The average number of fibres that are produced on the surface of a cotton seed may be estimated by any of the following methods: (*a*) By the method employed by Turner, where the variations in the length and weight of the fibres that make up the sample are taken into account. (*b*) By dividing

the lint weight per seed by the product of the mean fibre length and the mean fibre weight per unit length, obtained by the ordinary cutting method. (*c*) By dividing the lint weight per seed by the unit fibre weight obtained by weighing whole fibres, as described by Nazir Ahmad. (*d*) By dividing the lint weight per seed by the mean unit fibre weight obtained in Turner's method. It is evident that this method is not independent, as it depends on the method (*a*) for the value of the unit fibre weight.

The author presents the following conclusions:

1. The average number of fibres per seed according to the ordinary cutting method (*b*) is a little smaller than that obtained by the method suggested by Turner (*a*). Where considerable accuracy is not needed, the ordinary cutting method may be employed with a positive correction of about 2 to 3 per cent.

2. The values obtained according to the method (*d*) also are less than those obtained by (*a*) by about the same amount. This difference has been shown to be due to the fact that (*a*) takes into consideration the distribution of the fibre-length according to the number of fibres, while (*d*) that according to weight, and there exists a slight variation between the two distributions.

[*Cf.* Abstr. **637**, Vol. VI., and **5**, Vol. IX., of this Review.]

297. COTTON NOTES. *Budding and Grafting Trials with Cotton and Related Plants.* By R. E. Beckett. In a review of this paper (*Trop. Agricultur*, xii., **1**, 1935. p. 10.) Dr. Harland writes: "This short paper describes budding and grafting trials between widely different species of *Gossypium*, and also between the genera *Gossypium, Thurberia, Paritium, Hibiscus, Thespesia*, and *Erioxylum*. The literature is briefly referred to, though there seems a slight reluctance to deal with the subject historically. For instance, since Smith (1909), working in Hawaii, was the first to demonstrate the practicability of budding cottons, it seems a little unnecessary to quote *unpublished* later observations by other workers merely going over the same ground.

"It may be mentioned that cotton was successfully grafted as early as 1871, for in the *Gardener's Chronicle* for that year, p. 1260, is a figure of a grafted seedling, the scion being united to the stock just below the cotyledons.

"Beckett found that *G. Sturtii* could be successfully budded on to *G. Davidsonii* and *G. arboreum*, and inarched with Upland types of cotton from lower California and Siam. *Thurberia thespesioides* was budded on *G. arboreum* and *G. calycotum*, while *Erioxylum aridum* was budded on to *G. arboreum*. These results are all consistent with our knowledge of the taxonomy of the genus *Gossypium*, since on both cytological and genetical grounds it is the consensus of opinion at this Station that both *E. aridum* and *T. thespesioides* are members of the genus *Gossypium*.

"It may be mentioned that the practice of budding or grafting species of *Gossypium* on other species has been in common use at this Station since 1926, and although a few combinations have not been tried, there is little doubt that all species of *Gossypium* intergraft with the greatest of ease.

"Of greater interest is Beckett's pronouncement that *Paritium tiliaceum* (*Hibiscus tiliaceus*) and *Thespesia populnea* can be successfully inarched with *Gossypium* and also upon each other. Between 1926 and 1930 the intergrafting relationships of *Gossypium* to other genera in the *Hibisceæ* were studied by the writer, but although a loose union was obtained between *Thespesia* and *Gossypium*, there was no evidence of any transference of nutrients from stock to scion. The scion could persist for several weeks in a green state, but failed to make independent growth, when all branches were removed from the stock.

"A photograph is presented in Beckett's paper of a plant of *G. Sturtii* carrying an inarched branch of *T. populnea*, but the plant still has a branch of the stock *G. Sturtii*.

"In considering the type of union between stock and scion, all stages seem to be possible between a loose association of cells which permits water to pass from stock to scion, but not nutrients necessary for growth, and a real bio-chemical union permitting normal growth and translocation of nutrients. In the opinion of the reviewer, the term 'successful grafting' should be confined to the latter type of union, and if this delimitation be accepted the question of whether success has been attained in grafting *Gossypium* with *Thespesia* or *Paritium* must be left open."

[*Cf.* Abstr. **224**, Vol. XI., of this Review.]

298. THE THEORY OF INBREEDING IN AUTOTETRAPLOIDS. By M. S. Bartlett and J. B. S. Haldane. (*J. Genet.*, **29**, 1934, p. 175. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 1.) Expressions have been found for the rate of decrease of heterozygotes when brother and sister are mated in a tetraploid species and various methods of building up a pure line are compared.

299. TECHNIQUE OF CYTOLOGICAL INVESTIGATIONS IN BREEDING WORK. By M. Nawaschin. (In German.) (*Z. Züchtung*, 1934, A19, p. 366. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 11.) The preparation of plant material and its examination, microtome technique, fixation, embedding, mounting, etc., are all described in considerable detail, and a bibliography referring to special points in the discussion is given.

300. SOVIET CYTOLOGY APPLIED TO PLANT INDUSTRY DURING RECENT YEARS, 1928-33. By G. A. Levitzky. (*Bull. Appl. Bot.*, Ser. A., **10**, p. 25, Leningrad, 1934. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 14.) Following upon a brief mention of the various cytologists now working in the U.S.S.R., the author refers to his own studies on the morphology of the chromosomes by the use of his special fixative, which has displayed the chromosomes of even well-known objects in a completely new light. Figures are given illustrating the difference between the old method and the new, whereby not only the size of the chromosomes can be fairly accurately measured, but their actual morphological characteristics made manifest.

301. A BIBLIOGRAPHY OF PLANT GENETICS. Compiled by M. F. Warner *et al.* (*U.S. Dpt. of Agr. Misc. Pubn.*, **164**, 1934. Abstr. from *Exp. Sta. Rec.*, **71**, **4**, 1934, p. 456.) Covering available literature through 1930, this comprehensive bibliography embraces 10,156 references, indicating those which have literature lists. Subject and author indexes are included.

302. ON THE DETERMINATION OF GENETIC CONSTANTS OF RELATIVE GROWTH. By A. H. Hersh and M. J. Feldstein. (*Amer. Nat.*, **68**, 1934, p. 72. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 11.) A comparison is made of the results obtained by two methods of applying the method of least squares in estimating the differences in the constants of relative growth brought about by relatively small genetic differences. Though the two methods give somewhat different results, no certain criterion has been yet established for deciding which of the two is preferable.

303. GENETIC ASPECTS OF PLANT AND ANIMAL BREEDING. By A. L. Hagedoorn. (In German.) (*Z. Züchtung*, 1934, A19, p. 414. From *Plant Breeding Abstracts*, v., **1**, 1934, p. 11.) The development of plant breeding and the various conceptions that have prevailed of its relations to genetics are outlined, and the value of co-operation between the experienced geneticist and the plant breeder is emphasized and exemplified by the advances that have been made following the introduction of progeny tests and selection according to the genotype.

304. TABLES FOR CALCULATING THE STANDARD ERROR AND THE PROBABLE ERROR OF THE COEFFICIENT OF VARIABILITY. By H. M. Brown. (*J. Amer.*

Soc. Agron., **26,** 1934, p. 65. From *Plant Breeding Abstracts*, v., **1,** 1934, p. 11.) The two tables provided do away with the necessity of resorting to the basic formulæ for the calculation of the standard error (S.E.) and probable error (P.E.) of the coefficient of variability (C.V.). The first table gives A for values of C.V. from 1 to 119, with first differences for interpolation purposes, and N (where N is the number of observations) is obtainable from any book of square roots; then S.E. of any particular C.V. is simply $A/\sqrt{N}$. The second table is similarly constructed so that P.E. of any particular C.V. is simply $B/\sqrt{N}$.

305. Cottonseed Oil from Bollies: Quality. By R. H. Fash. (*Oil and Soap*, xi., **106,** 1934. Abstr. from *Summ. of Curr. Lit.*, xiv., **22,** 1934, p. 614.) Immature cotton bolls, known as "bollies," give cottonseed oil that has a higher refining loss than that from ripe seeds, and if mixed with normal oil detracts from its colour.

FIBRE, YARN, SPINNING, WEAVING, ETC.

306. Cotton: From the Raw Material to the Finished Product. By R. J. Peake. (Fourth edition. Revised and enlarged by H. P. Curtis. Pubd. by Sir Isaac Pitman and Sons, Ltd., London; price 5s. net. From *Text. Rec.*, lii., **620,** 1934, p. 58.) The first chapter outlines the foundation of the English cotton trade and its subsequent development. The next three chapters, which together form the greater portion of the volume, deal respectively with cotton growing, preparatory and spinning processes, and winding, warping, and weaving. New inventions are considered in these sections. The following two chapters are given over to the study of bleaching, printing, and dyeing, and market distribution of yarn and cloth, while the last two chapters give some interesting particulars regarding trade unions and masters' organizations respectively.

307. Cotton Bag Fabric: Structure. By R. J. Cheatham and J. T. Wigington. (*U.S. Dpt. Agr. Misc. Publ. No.* 175. Abstr. from *J. Text. Inst.*, xxv., **12,** 1934, A567.) Illustrations are given of the application of cotton bags in the marketing of farm produce. A description is given of a popular fabric used for the purpose.

308. Cotton Hair: Direction of Convolutions. By O. Roehrich. (*Chim. et Ind.*, 31, 13*e Congrès Chim. Ind.*, *No.* 819, 1934. Abstr. from *Summ. of Curr. Lit.*, xiv., **22,** 1934, p. 603.) The convolution of Egyptian cotton hairs and of collodion tubes filled with water is studied under the microscope, and it is shown that the direction of twist is invariably determined by the direction of the helical striations of fibrillæ of the secondary membrane. Photomicrographs are reproduced.

309. Immature Cotton Hairs: Classification by Polarization Microscope. By C. L. Pattee. (*Text. World.*, **84,** 1934, p. 2012. Abstr. from *Summ. of Curr. Lit.*, xiv., **22,** 1934, p. 604.) A technique is developed for using the polarization microscope to determine the degree of maturity of cotton fibres. Low maturity fibres change to blue or indigo as rotation brings them parallel to the cross-hair in alignment with the selenite plate, whilst mature fibres show little colour change on rotation. A system of evaluation of the fibres is derived so that a "maturity rating" can be found for each slide.

310. Cotton Linters: Analysis. By A. P. Zakoshchikov. (*Iskusst. Volokno*, v., **1,** 1934, p. 36. Abstr. from *Summ. of Curr. Lit.*, xiv., **22,** 1934, p. 603.) Impurities in linters are determined as follows. About 1·5-3 g. are exposed to the fumes of hydrochloric acid for about one minute, then to ammonia, washed, dried, and dissolved in cuprammonium. The insoluble residue is washed, dried, and weighed.

311. Cotton Sails. By T. W. McAlpine. (*Text. Rec.*, lii., **618,** 1934, p. 20.)

Explains how cotton sails came to be used for racing yachts, and discusses the advantages of cotton over flax for this purpose.

312. SIMPLIFIED COTTON SPINNING SYSTEM. (*Revue Text.*, **32**, 1934, p. 787. Abstr. from *Summ. of Curr. Lit.*, xiv., **23**, 1934, p. 629.) Describes a system in which it is possible to work mixtures of inferior quality cotton with cotton of long staple.

313. COTTON STALKS: USE IN PAPER MANUFACTURE. By A. I. Lourié. (*Boumajn. Prom.*, 13, **3**, 1934, p. 61. Abstr. from *Summ. of Curr. Lit.*, xiv., **22**, 1934, p. 583.) Soudakov's method, or the method of gradual treatment, can be used to manufacture pulp or packing paper from cotton stalks. The paper shows a tendency to crumble owing to the presence of fragments of parenchyma. The gradual method of treating the stalks with caustic soda gives a much stronger paper than that of Soudakov.

314. COTTON WASTE: USE FOR RAYON MANUFACTURE. By Y. Uno. (*Text. Mfr.*, **60**, 1934, p. 369. Abstr. from *Summ. of Curr. Lit.*, xiv., **20**, 1934, p. 526.) The Japanese rayon industry has reached second place in the world's production. Most of the raw material is imported, but investigations of the possibility of using waste cotton have been carried out. A satisfactory pulp has been obtained by boiling cotton wastes such as fly, oily cotton, and floor sweepings, under pressure for about five hours with a solution containing 1 per cent. caustic soda and about 2 per cent. dissolved hemicellulose which is prepared from the waste solution at the viscose rayon mill after the recovery of caustic soda by means of a dialyzer. Viscose rayon produced from this pulp has a good lustre, and is 20 to 30 per cent. stronger than that made from wood pulp. In view of the high cellulose content of the waste cotton pulp and its low cost, it is estimated that, for a given quantity of rayon yarn, the cost of the required pulp from waste cotton is only about 25 per cent. of that of wood pulp, or 10 per cent. of that of ordinary linter pulp.

315. COTTON YARN: COUNT AND STRENGTH DETERMINATION BY THE LEA TEST. By J. L. Delany. (*Cotton*, U.S., 98, **10**, 1934, p. 61. Abstr. from *Summ. of Curr. Lit.*, 1, **24**, 1934, p. 670.) The use of the lea test for the determination of yarn counts and strengths is discussed, and precautions to be taken in the reeling and breaking operations are indicated. The influence of moisture is described and correction formulæ are given. The use of the break factor (count × strength) is explained, and methods of expressing count variations and of checking yarn counts on the warp beam are briefly described.

316. STUDIES IN THE SAMPLING OF YARNS FOR THE DETERMINATION OF STRENGTH PROPERTY. PART I. FREQUENCY CURVES OF STRENGTH TESTS BY SINGLE THREAD, LEA, AND BALLISTIC METHODS OF TESTING. By D. F. Kapadia. (*J. Text. Inst.*, xxv., **11**, 1934, T355.) In Part I. of the present series is shown the extent to which departure may be experienced from the *normal law* in sampling. It is pointed out that the values of observations not only depend on the distribution of accidental influences—errors in the true sense of the word—but are also subject to persisting influences. Therefore, the variability is the resultant of a number of contributory causes tending to produce asymmetrical frequency distribution. Recognizing this difficulty, in Part II. of the series the methods of determininng trustworthy estimates of means within assigned limits will be examined, and the number of tests constituting a satisfactory sample, representing the bulk from which it is drawn, is indicated.

317. COTTON YARNS AND FABRICS: REGAIN/STRENGTH RELATION. By K. K. Thomas. (*Ind. Text. J.*, **44**, 1934, p. 394. Abstr. from *J. Text. Inst.*, **xxv.**, **11**, 1934, A547.) Various methods of determining regain are discussed, and a

table is given for finding the correct tensile strength for fabric and yarn at various moisture regains.

318. COTTON YARNS AND FIBRES: ELASTICITY. (*Spinn. u. Web.*, 52, **42**, 1934, p. 1. Abstr. from *Summ. of Curr. Lit.*, xiv., **22**, 1934, p. 604.) The usua method of determining elasticity is discussed, and results for cotton yarns and fibres are given in the form of tables and graphs showing the total, residual, and elastic extensions for varying loads. It is pointed out that the full extension and contraction are not attained immediately upon application and removal of the load, and if periods of 1 or 2 minutes are allowed to elapse before the readings are taken the calculated elasticity is higher than that determined from readings taken immediately after application and removal of the loads. The difference varies from 3 to 7 per cent. for samples of 20's cotton yarn prepared by different carding treatments.

319. FIBRES: MOISTURE RELATIONS. By E. Burlet. (*Bull. Lab. d'Analyses et Recherches Industrielles, Roubaix*, 1934, *Nos.* 22 *and* 23. Abstr. from *J. Text. Inst.*, xxv., **11**, 1934, A546.) Experiments on the moisture regain of textile fibres show that this occurs in two stages, one of rapid superficial regain, and the other of slow deep absorption. The phenomenon of hysteresis is discussed and also the effect of drying at 106° C. on the hygroscopic power of fibres. The maximum difference between absorption and desorption regain at 18° and 65 per cent. R.H. (the "normal" atmosphere) amounts to about 2·5 per cent. for rayon, 2 per cent. for wool, and 1·75 per cent. for cotton, and the effect of heating at 106° C. is to depress the regain by about 0·67 per cent. for bleached rayon, 0·5 per cent. for cotton, and 0·33 per cent. for wool. Methods of conditioning and determining regain are discussed.

320. FIBRES: MOISTURE RELATIONS. By W. Weltzien. (*Monats. Seide u. Kunstseide*, **39**, pp. 343 and 390. Abstr. from *J. Text. Inst.*, xxv., **11**, 1934, A546.) Previous work on the absorption of moisture by fibres is reviewed, and an apparatus for studying absorption, based on Katz's method, is described.

321. FIBRES: FLUORESCENT MICROSCOPY. By E. Göthel. (*Dissertation*, Dresden, 1933. Abstr. from *J. of Text. Inst.*, xxv., **9**, 1934, A456.) The author describes the Reichert fluorescence microscope (1931 model) and the appearances presented by various cottons, other plant hairs, bast fibres, wool and other animal fibres, silk, asbestos, rayons and gums, softeners, filling materials and antiseptics used in finishing textiles. Two chapters are also devoted to paper-making materials. A review of previous work and a bibliography are provided.

322. UTILISATION DU COTON POUR LES USAGES AUTRES QUE LA FILATURE. By J. Dantzer. (*Agron. Col.*, xxiii., **197**, 1934, p. 129. Abstr. from *Bull. Imp. Inst.*, xxxii., **3**, 1934, p. 490.) Notes on various uses of cotton other than for the usual purposes of fabrics.

323. IMPORTANCE OF INTERPRETATION TO TEXTILE RESEARCH. By E. R. Schwarz. (*Text. Rec.*, lii., **621**, 1934, p. 33.) Stresses the need for the translation of the findings of present and past textile research workers into terms which can be appreciated by the textile executives.

324. SISAL COTTON BALE COVERING: INFLUENCE ON SPINNING. (*Text. Mfr.*, **60**, 1934, pp. 349 and 355. Abstr. from *Summ. of Curr. Lit.*, xiv., **20**, 1934, p. 528.) **Tests were made on ten bales of medium-stapled American cotton, of which five were jute covered and five had the inner covering of sisal and the outer covering of jute. Both kinds of bales had sisal cords which provided a possible source of sisal even in the jute-covered bale. The cotton tended to adhere more to a jute covering than to a sisal covering, but more sisal was left on or in the cotton by a broker's sampling out. The cotton was processed in**

the ordinary way, and spun into 32's twist. The results of observations of breakages in mule spinning and their causes are given. The spinning was good, with about ten spinning breakages per 100 spindles per hour, and neither the sisal nor jute fibres were directly responsible for any appreciable percentage of the spinning breakages. The conclusion is reached that there is no appreciable difference in the number of spinning breakages corresponding to the two types of cover. This conclusion has been confirmed by an independent test on Middling American cotton.

325. DEVELOPMENTS IN MACHINERY. By F. Nasmith. (*World Textiles Supplement, Man. Guar. Coml.*, 6/10/34.) The character and value of many of the improvements offered are on a higher plane than hitherto. Various machines are described.

326. COTTON MACHINERY: OBSOLESCENCE. By (1) T. Spencer; (2) British Northrop Loom Co., Ltd. (*Text. Weekly*, **13**, 1934, p. 408. Abstr. from *J. of Text. Inst.*, xxv., **9**, 1934, A468.) (1) Spencer produces cost figures showing that the weekly cost of production for 181 yards of 35-inch fabric is 171·92 pence in a mill with six looms per weaver, and 183·5 pence in one equipped with fully automatic looms (twenty per weaver). The chief extra expense allowed for the automatic looms is interest on capital and depreciation. (2) British Northrop Loom Co., Ltd., point out that these figures are based on the first year, that the loom speed for a modern automatic is 180, not 170 as stated, and that the number of looms per weaver and per overlooker are too small. They state that obsolescence, not low efficiency, is the chief trouble.

TRADE CO-OPERATION, ETC.

327. LA RIDUZIONE DELLA DURATA DEL LAVORO NELLE INDUSTRIE (REDUCTION OF THE HOURS OF LABOUR IN INDUSTRY.) By F. Magri. (*Boll. della Coton*, Milan, xxix., June, 1934, p. 362.) The problem has been brought up by a report published in Geneva. Insurance against unemployment being unsatisfactory, reduction of hours of labour is considered. Such a solution would inevitably encounter many difficulties, and these are discussed.

328. FORECASTING RAW COTTON PRICES. By W. H. Slater. (*Text. Wkly.*, xiv., Nos. 351 and 355, 1934.) The third paper of this series deals with the scope of statistical methods and the time factor, and the fourth with the working out of monthly prices on Method "A."

[*Cf.* Abstr. **171** of this volume.]

329. FLUCTUATIONS IN PRICES OF COTTON FUTURES CONTRACTS. By L. D. Howell. (*U.S. Dept. Agr. Tech. Bull.* **423**, 1934. Abstr. from *Exp. Sta. Rec.*, **71**, **5**, 1934, p. 719.) This is a study of the extent and distribution of actual daily and weekly fluctuations in cotton futures prices on the New York Cotton Exchange from August 1, 1917, to August 1, 1933. The daily ranges in prices of contracts above and below the lowest price of the closing range for the same month on the preceding business day were calculated. The ranges in price fluctuations during the day and during the week were also tabulated, and are summarized in the tables and charts presented.

"The results of this study of fluctuations in prices of cotton futures contracts show that for contracts bought and sold prior to the month of their maturity the range in prices during the day equalled or exceeded 2 ct. per pound only nineteen times, or about 0·4 per cent. of the time, during the sixteen-year period 1917-18 to 1932-33. Fluctuations in prices above and also below the closing price on the previous day each exceeded 2 ct. per pound only six times, or approximately 0·1 per cent. of the time.

"Changes in prices during the day were less, on the whole, for contracts bought and sold during the month of their maturity than for contracts of other months.

"The extent of price changes during the day varied directly with the level of prices of the contracts. The range of prices during the day and fluctuations in prices above and below the closing price on the previous day increased progressively from the lower to the higher price-level groups.

"Analyses of the data on the basis of graduated limits indicate that changes in the price level of cotton futures contracts were generally associated with corresponding proportional changes in prices during the day and during the week."

330. THE WORLD COTTON POSITION. By J. A. Todd. (*Trop. Agriculture* xii., **1**, 1935, p. 16, and **2**, p. 48.) I. A very readable article. The behaviour of prices in relation to supplies and consumption is considered for the last few years, and in conclusion the author writes: "Is it possible to draw from all this any general conclusion as to the whole position? Perhaps this much may be risked. Production, consumption, and prices have all made a pretty good recovery from the low points of a year or two ago, but the critical feature of the whole situation is that the recovery during 1933-34, both in production and consumption, was much more marked in the case of Outside Growths than of American, because America's efforts to restrict production were only then beginning to show results."

II. In the previous article the writer brought his survey of the position down to season 1933-34, and it is shown in the present paper how that position has been affected by developments regarding the current season 1934-35.

331. WORLD COTTON TRADE. By Reiss Bros. (*Text. Wkly.*, xv., **357**, 1935, p. 8.) A review of the textile trade in the principal manufacturing centres of the world in 1934.

[illegible]DENDA.

332. THE THEORETICAL SIGNIFICAN[illegible]F VERNALIZATION. By N. A. Maximov. (*Bull. No.* 16, Herbage Publication[illegible]es. Published by the Imperial Bureau of Plant Genetics, Aberystwyth, [illegible] 1934, price 2s. 6d.) Vernalization, or "jarowization," is the term used [illegible]nify the discovery made by Lysenko at the Odessa Institute of Plant Bree[illegible] It is a practical agricultural method of hastening development, making win[illegible]nts fruit in the first year, and late flowering plants become early. The se[illegible] soaked, but only partially, so that it does not come into full growing activity, but it may be subjected to other influences that hasten development. If, for example, it is exposed for two to ten weeks (according to variety) to a temperature little above freezing-point, it acquires the properties of a spring (jarovye) plant, and may even produce a yield earlier than a spring variety of the same plant. In warmth-loving plants, on the other hand, such as millet, soy-bean, or cotton, the factor of vernalization may be increased temperature.

The efficiency of the method is shown by the fact that in 1934 about a million hectares were sown with vernalized seed, with very few failures. Oats and barley were matured by this method within the arctic zone, where it had hitherto been regarded as impossible to do so.

Professor Maximov goes on to attempt to throw light upon the theoretical side of the process. Lysenko himself, in one of his recent papers, briefly formulates his theoretical conceptions as follows: (1) Growth and development are not identical phenomena; (2) The entire process of the development of an annual seed plant consists of individual steps or stages; (3) The stages always proceed in a strict sequence, and a subsequent stage cannot set in until the

preceding stage has been completed; (4) Different stages of development of the same plant require for their completion different external conditions.

Each of these statements is analyzed in some detail, and in the view of the author, "the theory of vernalization is as yet far from being completely formulated."

The paper concludes with a review of the work that preceded and accompanied that of Lysenko, bearing upon the same question. The whole paper should be carefully studied.

333. Reports Received from Experiment Stations, 1933-34. (Pubd. by the Empire Cotton Growing Corporation, 1935, price 2s. 6d., post free.) The Reports of the Corporation's Experiment Stations are presented this year in a different form, as the result of recommendations made at the Cotton Conference held last year. It was decided to issue two separate publications, one to be a small volume (cf. Abstr. 334) intended primarily for the Corporation's own members and the general public, consisting of a general review in non-technical language of the work of each Station for the previous season. Secondly, each Station was asked to furnish a progress report summarizing the work done at each Station in the last season alone, such as would suffice to enable other Stations to learn the kind of experimental work that is being done at each place, and the general trend of the results of the last year. Details of experimental procedure and of numerical results are not included in such a progress report, since they would naturally be included when, after a suitable number of years' repetition, the work was recorded in a paper in a scientific journal. It was considered that until a piece of work had reached this stage, other Stations should content themselves with an indication of the direction in which each season's results were pointing. Progress reports from the Cotton Experiment Stations in the Sudan, Nyasaland, South Africa, Rhodesia, Swaziland, Uganda, Tanganyika, Queensland, St. Vincent, Fiji, and the Seed Farm in Nigeria, are contained in the present volume.

It is greatly hoped that this new scheme for the reports will be successful in providing the general public and workers on cotton-growing problems with such information as they wish to have regarding the progress made each season at the several Experiment Stations.

334. A Review of the Work of the Experiment Stations, Season 1933-34. By J. C. Willis, F.R.S. (Pubd. by the Empire Cotton Growing Corporation, 1935; price 1s. 6d., post free.) This review is an endeavour to incorporate the progress reports of the Experiment Stations into a single article in non-technical language, which shall give a general account of what is going on, and what progress is being made towards the realization of the aims that the Corporation has in view. Section I. of this review deals with Plant Breeding; Section II. with the Improvement of Agricultural Practices; Section III. with Pests and Diseases. An index to individual Stations is included.

335. Unity National and Imperial. By H. Martin Leake. (With a Preface by Sir Edward Grigg. Pubd. George Allen and Unwin Lid., London, 1935; price, 8s. 6d.). With a wide experience of the British Empire, the author discusses two major problems of the day—British agriculture and Colonial development. The weakness of the former is shown to lie in its financial structure, and proposals are put forward by which agricultural and industrial finance may be harmonized to the great advantage of the former industry. The same proposals are further shown to offer the one means of fulfilling our trust to the native populations of the Empire. This financial harmony is then used to indicate how the best in capitalism and socialism may be woven to give a complete unity in national and Imperial economy.

REPORTS RECEIVED FROM EXPERIMENT STATIONS, 1928-29 AND 1929-30. We have been asked by Sr. Arnaldo Vieira de Mello, of Pernambuco, Brazil, to obtain for him if possible one copy of each of the above Reports, which are now out of print. He offers 5s. each for the two volumes, and if any reader has copies that are no longer required he should communicate direct with Sr. Arnaldo Vieira de Mello, Estaçao Experimental de Plantas Texteis, Surubim, Pernambuco, Brazil.

PERSONAL NOTES

We much regret to announce the death on February 7, at Keltie, Perthshire, of the Hon. Bernard Rollo. Mr. Rollo was a member of the Administrative Council and of the Finance Committee of the Corporation.

We beg to offer our sincere congratulations to the President of the Council of the Corporation, Lord Derby, on the bestowal on him of the Royal Victorian Chain, announced in the New Year's Honours List. We also tender our warm congratulations to Sir John Shute on the honour of Knighthood conferred on him, and to Professor F. L. Engledow, a member of the Corporation's Research Station Committee, on receiving the honour of C.M.G.

Mr. Milligan's long record of service with the Corporation as their senior representative in South Africa has now terminated. He joined the staff in 1924, coming from India with a distinguished reputation which his work while in Africa has enhanced. In addition to his normal duties, he has made important contribution to agricultural progress in the Rhodesias, Tanganyika, and Nyasaland, while his services as economic adviser to Sir Alan Pim, who has recently reported to the Secretary of State for the Dominions on the High Commission Territories, have contributed much to the elucidation of a difficult agricultural situation. Mr. Milligan's departure means that the Corporation lose the services of an officer of outstanding ability, beloved by his staff and trusted by all.

APPOINTMENTS.

Mr. D. F. Ruston, a former holder of a Studentship, has been appointed by the Corporation as an Assistant at the Cotton Breeding Station, Barberton, South Africa.

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W.1.

At the date of writing the following officers are on leave, or will shortly be arriving in England, from cotton-growing countries:

British Honduras	Mr. H. P. Smart.
Ceylon	Mr. F. P. Jepson.
Fiji	Mr. C. R. Turbet.
Gold Coast	Mr. E. M. Cook.
,, ,, ...	Mr. J. K. Cox.
,, ,, ...	Mr. H. E. Green.
,, ,, ...	Mr. R. J. T. Hooke.
,, ,, ...	Mr. C. L. W. Jones.
,, ,, ...	Mr. A. C. Miles.
,, ,, ...	Mr. H. Nicholas.
India	Dr. W. Burns.
,, ...	Mr. W. J. Jenkins.
Kenya Colony	Mr. J. Anderson.
,, ,, ...	Mr. J. T. Denwatt.
,, ,, ...	Mr. A. M. Gwynn.
,, ,, ...	Mr. V. Liversage.
Nigeria	Mr. V. F. Olivier.
Northern Rhodesia	Mr. J. N. Clothier.
,, ,, ...	Mr. C. G. Trapnell.
Tanganyika Territory	Mr. A. E. Haarer.
,, ,, ...	Mr. L. F. Higgens.
,, ,, ...	Mr. T. S. Jervis.
,, ,, ...	Mr. G. Milne.
,, ,, ...	Mr. W. H. Potts.
,, ,, ...	Mr. J. Robertson.
Uganda	Mr. T. R. Hayes.
,, ...	Mr. J. D. Jameson.

Sir Geoffrey Evans, Principal of the Imperial College of Tropical Agriculture, Trinidad, and Controller of the Corporation's Research Station in that island, will arrive in this country on leave in May.

The following officers of the Corporation's staff abroad will arrive in this country on leave during the next few weeks :

Nyasaland	Mr. S. T. Hoyle.
South Africa	Mr. O. V. S. Heath.
,, ,, ...	Mr. D. MacDonald.
,, ,, ...	Mr. E. O. Pearson.
Swaziland	Mr. H. Hutchinson.
Sudan	Dr. H. Greene.
,, ...	Mr. R. L. Knight.
,, ...	Mr. T. Trought.
West Indies	Dr. S. C. Harland.
,, ,, ...	Dr. T. G. Mason.
,, ,, ...	Mr. R. A. Silow.

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THE ORIGIN AND DEVELOPMENT OF U.4 COTTON

BY

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THIS article is written by special request to supply some answer to queries regarding U.4 and its origin. It is mainly a summary of information appearing in the annual reports of the Barberton Station for the past ten years.

When work was started at Barberton in 1924 the chief limiting factor to successful cotton growing in the Low Veld of South Africa was the damage caused by jassid. The varieties then in cultivation were all susceptible to this pest to a greater or less extent, but in most cases the plant-to-plant variation in this character was very marked. An immediate start was made, therefore, with selection work directed to the production of jassid-resistant types.

The most promising of the local varieties from which to make selections were *Improved Bancroft*, *Zululand Hybrid* and *Uganda*. The first two were about equal in their average susceptibility to jassid; Uganda was rather better, though still subject to serious damage. It was found, in all three varieties, that most of the highly resistant plants were poor fruiters or carried lint much shorter than the average. In spite of this, however, it was possible, by prolonged search, to find a number of plants which combined high resistance to jassid with heavy fruiting and good lint. This combination was less easily found in Uganda, hence this variety yielded very few suitable plants compared with the other two. One of the Uganda selections, however, was U.4, and this strain in a very few seasons proved markedly superior to everything else on the Station.

The origin of the variety grown under the name of *Uganda* was by no means certain, as the evidence obtainable was most conflicting.

It may have been derived from cotton seed that had been imported from Uganda in the past, but this cannot be stated as a fact. Whatever its origin, however, it was very mixed and hardly recognizable as a definite variety.

The original U.4 plant was selected in 1925 (1924-25 season). It was smaller and more compact than the general run of Uganda plants, with small leaf and fine wood. It was only slightly affected by jassid, even towards the end of the season, and at the same time carried a very good crop for a small plant. The boll was small, 4·3 gms. boll weight, compared with a mean of 6·6 gms. for Bancroft and 5·5 gms. for Zululand Hybrid selections; moreover the lint was short, 28 mm. compared with an average of about 30 mm. for the whole lot of selections. Both these characters were marked down against it, but it was too good in other ways to be discarded.

In the 1925-26 season the first progeny row was by no means uniform, but showed variation, obviously due to segregation, in various characters. There was some variation in habit, but the plants were all of one general type, very like the parent and easily recognizable from other selections. A particularly noticeable feature was the very free flowering, a large number of squares and flowers being greatly in evidence throughout the main season, and this, together with excellent setting, resulted in the rapid production of a heavy crop of bolls. This feature is very characteristic of U.4 and is one of its most valuable economic characters. Resistance to jassid was somewhat variable, though definitely good on the whole. The length of lint varied considerably, the bulk of the plants ranging from about 28 to 35 mm., but with some definitely shorter. The lot contained about 250 plants thus providing good scope for re-selection, and it was possible to find many plants combining good jassid-resistance, a heavy yield, and lint of about 30 mm. or over. Some of these were taken as single-plant selections and a " Special Bulk " was made of a further 35 plants.

Of the main batch of 1926 progeny rows about 40 were carried forward, and of these U.4 was looked upon as being one of the really good ones, though not actually the best.

The 1926-27 season was the driest on record, the total rainfall for seven months, October to April, being only 15·3 inches. The selections as a whole grew very badly and gave miserable yields, but U.4 and one other strain, A.12, behaved very well and proved decidedly better than anything else. One acre of U.4 Special Bulk, though planted thinly and heavily rogued during the season, gave 750 lbs. of seed cotton, an astonishingly good yield for the conditions. From

this time forward U.4 and its sub-strains behaved consistently well, and by 1929 they had established so great a superiority over everything else that all other types, including A.12, were discarded completely from the regular breeding work.

The following table gives the results obtained, for two seasons and in three localities, from variety trials in which U.4 was compared with the local variety most commonly grown in the locality concerned. The figures show the immense superiority of U.4 over the local variety in each case, and the good yields it gave in all six sets of conditions. It may be mentioned that most growers at that time looked upon 500 lbs. per acre of seed cotton as a definitely good yield.

U.4 COMPARED WITH LOCAL VARIETIES

Locality.	*Season.*	*Lbs. per Acre Seed-Cotton.*		*Name of Local Variety.*
		U.4.	*Local Variety.*	
Barberton, East Transvaal ...	1927-28	830	335	Improved Bancroft
,, ,, ,, ...	1928-29	1,012	303	,, ,,
	Mean	*921*	*319*	
Bremersdorp, Swaziland ...	1927-28	1,055	544	Uganda
,, ,, ...	1928-29	1,226	467	,,
	Mean	*1,141*	*506*	
Magut, Zululand	1927-28	780	431	Zululand Hybrid
,, ,, ...	1928-29	903	621	,, ,,
	Mean	*842*	*526*	

Owing to the extremely urgent need of a good jassid-resistant strain, preliminary multiplication of the most promising lots was carried out, from the beginning, concurrently with other work on them. The multiplication of U.4 was specially pushed after it had shown up so well in the dry season, 1926-27. The growers who helped in this multiplication by putting in small plots of a few acres each, were extremely pleased with their results, and an insistent demand for seed immediately arose. By 1929 200 tons were available for distribution throughout the Low Veld, and all other varieties were quickly replaced by this strain.

The following record shows the rapidity with which U.4 came forward. It is not remarkable from the point of view of actual multiplication, but is a good record for the whole sequence of selection, testing in variety trials and under ordinary cultivation, multiplication and large-scale distribution.

1925. One plant.
1926. Progeny row, 250 plants, giving a Special Bulk of 35 plants.
1927. One acre of Special Bulk, 475 lbs. seed.
1928. A few farms, small plots, 8,885 lbs. seed.
1929. Many farms, large plots, 220 tons seed.

The one acre of U.4 Special Bulk grown in 1926-27 was heavily rogued, chiefly for habit and resistance to jassid. The resulting bulk was grown on without further systematic rogueing, though a few obvious off-types were removed from multiplication plots in the following year. This bulk naturally showed a good deal of variation inside the general type, but no hesitation was felt in putting it into general cultivation since, as it stood, it was such a great improvement on the local varieties. Moreover, the matter was extremely urgent, and if several years had been spent in getting it more uniform before distribution, cotton growing in the area would probably have died out completely in the meantime.

Single-plant selection work was started on the first progeny row of U.4 in 1926 and has been going on continuously since that time. The early selections were cut about badly by a hail-storm in the 1927-28 season, and some of the material was lost. A number of multiplication plots of bulk on farms in the district escaped damage, however, and about 200 new selections were made from these plots to supplement the older material. The plants selected were all promising economic types, possessing a sum-total of characters likely to make them useful in actual practice, but they were chosen to cover a wide range in habit, duration, etc.

A difficulty in carrying out selection work in this area arises from the large variation in conditions that may occur from season to season. The reaction to different types of season varies considerably from strain to strain. Thus, poor growing conditions may favour a strong, more vegetative type as against a smaller, essentially fruiting type; whereas in good conditions the latter will make an excellent crop whilst the strong type will be apt to run to wood. It was for this reason that a wide range of types was taken in making selections, the policy being to narrow these down gradually, after experience with them in different conditions, rather than to discard all but a few of the best in any one season.

It is a great help to grow the strains in several different localities, as the conditions are seldom the same, and one season may give results from several sets of conditions. As a rule this can only be done with strains of which small bulks are available, to give enough

seed for division, and a practice has been made of taking special bulks of promising strains at a very early stage and growing them in Swaziland and Zululand in addition to Barberton. These bulks are made up normally of about thirty good typical plants taken to represent a strain as it stands.

When making single-plant selections from any important lot, a special bulk is also commonly taken and grown alongside the selections in later seasons. This practice was started largely to avoid the risk of losing jassid-resistance in seasons when there was not enough jassid to show up small differences in susceptibility. It has formed a useful check on the effects of selection generally, however, particularly in connection with the type of seasonal variation referred to above.

The selection work has been hampered at times by difficult conditions, but good progress has been made in spite of this. The original types separated have been narrowed down considerably, some very quickly, others on their showing over a number of seasons. They have been judged mainly on a basis of lint-yield without loss of desirable lint characters, and on this basis of selection the more extreme types are gradually dropping out and the better strains are tending more and more to one common type.

It has been found that the pursuit of any one desirable character, without constant attention to others, quickly renders a strain useless. Thus a greater length of lint can be obtained very easily, but at the price of reduced yield or greater susceptibility to jassid, commonly both, and similarly jassid-resistance can be increased at the expense of yield or length of lint. In both cases this is partly a causal effect, as a light yield tends to longer lint and greater resistance. On the other hand, there appears to be a genetic connection between short lint and hairiness of the plant, the latter being a factor in resistance to jassid.

There is comparatively little variation in the class of lint produced by the strains that are thoroughly satisfactory in the field. Most of them give a staple of Full 1⅛ ins. in ordinary conditions, Shirley Institute " Effective Length " of 38-40 thirty-seconds of an inch, and a good yarn when spun to 40's and 50's. Some improvement on this class of lint may be possible eventually, but great caution is necessary in attempting to get this, or more desirable characters may be sacrificed. The general conditions of the area are such as to emphasise the importance of good behaviour in the field, and it is essential for the continued success of a strain that it should be as safe as possible—*i.e.*, not liable to a bad failure when conditions are

unfavourable. Farmers in the district now look upon 300 lbs. of lint per acre as a very ordinary yield which is quite often exceeded, more than twice this amount being recorded occasionally from specially good patches. On the other hand, it requires really bad conditions to reduce the yield below 200 lbs. of lint per acre.

Some of our most promising strains, over a variety of conditions, are derivatives of U.4.4, the parent of all the really early lines. U.4.4.2, the earliest of all, though an excellent fruiter, was hardly strong enough for safety in our conditions. One or two of its stronger derivatives are still under trial, but several newer selections, direct from U.4.4 again, are almost certain to be better in that they are equally heavy fruiting and early, but also are rather stronger and finish out better. The later types are gradually taking a back place, and one of these, 920, a strain of which we had great hopes for several seasons, looks like dropping out eventually, now that stronger early types are coming on.

It should be mentioned that U.4 has shown considerable adaptability in that it has been very successfully grown in countries far from its place of origin. In the early years of its development it was sent to Southern Rhodesia and Nyasaland, in both of which countries it quickly replaced other varieties and was made the main material for selection work for local conditions. It is the only variety that has shown any promise so far in Northern Rhodesia. The early strain, U.4.4.2, has given some promising selections in the Serere Zone of Uganda and has been tried with a certain amount of success in Tanganyika; it appears doubtful, however, whether it will be really useful in the latter country.

A new line of work is now in progress in which U.4 has been crossed with a number of other varieties. The crosses were made by Dr. Harland in Trinidad and the material sent to Barberton after being carried forward by Mr. Evelyn in St. Vincent. The only part of this material that shows real promise at Barberton is that derived from U.4 crossed by Cambodia and back-crossed by U.4. The main object of this was to combine the very hairy Cambodia leaf, with its virtual immunity to jassid, with the many desirable characters of U.4. It is too early to say how this is likely to succeed, but the material is definitely promising. It is obvious, however, that the difficulty will be to get back unimpaired the desirable habit, earliness, heavy fruiting and non-shedding characters of U.4.

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COTTON IN SWAZILAND

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ACCOUNTS of the general development of Swaziland and of the position of the cotton-growing industry in the country have appeared from time to time in the Review, and in the present article it is proposed to bring the account up to date and to include an outline of the work in progress at the Corporation's experiment stations.

The last paper appeared in 1929, just at the period when the U.4 cotton was displacing the previous more or less jassid-susceptible varieties as the main seed of the country. Cotton prices were still remunerative and, with the change over to a more productive and more reliable variety of cotton, the outlook for cotton growers was bright. Considerable areas of land in the Low Veld had been opened up by individuals and companies for large-scale production, and with the extension of the railway to the Swaziland border at Gollel and the inauguration of a service of motor-buses linking up the country with the railways at Gollel in the south and Breyten in the west, further development and settlement was envisaged.

The potential cotton-growing areas can be divided into the Low Veld with an altitude of from 500 feet to 1,500 feet and the Mid Veld averaging about 2,000 feet. The Low Veld comprises a strip of land some miles wide of gently undulating country rising into low ridges to the west and then falling again to the north and north-west. The average rainfall is around 20 inches annually and is often somewhat erratic in its distribution. One of the main problems in this area lies in the often scanty and late planting rains which make it difficult to get the crop planted and successfully established. Above 1,500 feet the Mid Veld begins and rises through more undulating and broken country to the mountains in the west. The average rainfall is around 30 inches and the temperatures during the growing season are lower than in the Low Veld. Owing to the earlier winter it is necessary to plant the crop as early as possible, but fortunately the rainfall is higher and more reliable than in the Low Veld.

Seasons and Crop.—Following a period of fairly low rainfall seasons, that of 1929-30 opened well with excellent and early rains, and in general the good conditions were maintained. Practically the entire crop was grown from U.4 seed and the country enjoyed its best cotton season as far as yields and total production were concerned. In that year the production rose to 2,150 bales of lint.

The 1930-31 season promised a further increase in acreage, but the rains arrived late and much of the crop was late planted. The early plantings gave good yields, but the late-planted crop was poor, owing to the short season and to the prolonged dry periods in the Low Veld, and the total production dropped to half that of the previous year. No damage was experienced from jassid, but bollworm—both red and American—was serious, particularly as the season was not favourable to recovery by the plants.

1931-32 was a most unfavourable season and the cotton acreage dropped sharply owing to the low prices and to the lack of adequate planting rains, particularly in the Low Veld. In what was the main cotton growing area in Southern Swaziland practically no cotton was planted, but a considerable amount of the previous year's crop was continued as ratoons. The crop, and particularly the ratoons, was almost a complete failure in that area owing to the poor rainfall and persistent hot and dry winds.

The following season, 1932-33, saw a further drop in acreage due to the same causes of late rains and low prices, the latter aggravated by the adverse exchange position. Growing conditions were on the whole better than in the previous season and, though the acreage was less than half of that of the preceding year, the production showed a slight increase.

The 1933-34 season opened with good planting rains in most parts. There was a revival of interest in the crop owing to its performance under low rainfall conditions, and though individual acreages were small, an increased number of farmers cultivated the crop. The growing conditions were more favourable and yields in general were higher in spite of losses from bollworm and locusts. The present season, 1934-35, was very promising until the end of January: good planting rains were received and the crop was well established. Conditions subsequently were extremely dry, practically no rain of any value falling in February and March, and it is feared that yields will be poor.

The statistics of production up to 1924-25 were included in an article in the Review of January, 1927, and the following figures give the position in subsequent years:

Season.	*No. of Bales of Lint (500 lbs.).*
1925-26	828
1926-27	580
1927-28	875
1928-29	1,331
1929-30	2,149
1930-31	1,020
1931-32	129
1932-33	138
1933-34	197

The production showed a fairly steady rise up to the 1929-30 season—the year marked by the bulk distribution of U.4 seed. The production in the more recent years has been negligible on account of the low prices realized for the crop and the extremely poor rainfall conditions. The bulk of the cotton during the period of highest production was grown in the Low Veld under large-scale operations, and at present the poor conditions have led to an almost complete abandonment of arable farming in that area. The position of the farming community in Swaziland, in particular in the Low Veld, during the seasons under review has been the worst in its history. In addition to the general fall in prices of agricultural produce the country has passed through a period of very trying climatic conditions.

One important result has been to change the agricultural outlook from the concentration on one crop or product to a more diversified system of farming based on a wider range of products. In addition to cattle, which is the main agricultural industry of the country, the staple product of the farmer is maize and to a much lesser extent beans. As will be discussed later, the native is at present a consumer of these products rather than a producer and seller, and a paying internal market existed for these crops where they could be grown successfully. With some exceptions little attention was paid to a system of crop rotation, due in some measure to the lack of a profitable market for other crops. With the succession of dry years the limitations of the maize crop have been demonstrated, particularly in its unsuitability as a commercial crop in the drier Low Veld areas. With the development of a system of more varied cropping and better cultural methods and a return to better rainfall years the agricultural industry of the country should show a steady progress along more stable lines than existed in the past. As a source of revenue and as a feature of the rotation system, cotton has definitely established itself during the past seasons as the crop best suited to stand up to the vagaries of the climate. In addition to its general suitability, other factors are tending to encourage the growing of cotton as one of

the staples of the country. It was noted earlier that the maize crop depends on the local demand from natives for its profitable disposal, and with improvement in agricultural methods among the native cultivators the latter are likely to become at least self-supporting. The future of the farmer in the cotton growing areas would appear to be along the lines of cattle rearing for beef or cream, with his arable farming including cotton as a money crop, and other crops such as cereals and legumes, which can be sold if a suitable market is available, or alternatively can be used as cattle food. These developments are being helped by the erection of a creamery locally, the breeding and feeding of improved beef cattle, and the possibility of the erection of a local oil-extracting plant to handle surplus cotton seed and other oil seeds such as groundnuts and soya beans.

Native Agriculture.—The most important development as far as the cotton crop is concerned is the interest that is being shown in the crop by the native population. In 1932 representations were made to the Government by the Paramount Chief of the Swazis for advice and assistance in introducing the crop to the native areas. In that season, 1932-33, a start was made with small plots in various areas to show how the crop should be grown. To give an adequate picture of the position it is necessary to discuss the present agricultural position of the Swazi. During the early part of the century and until the partition of land between the concessions and the areas delimited for native occupation, the Swazi had large areas available for hunting and for cattle grazing. Food crops—mainly maize and kaffir corn—were grown, and with ample land available for shifting cultivation sufficient produce was grown in most years for his own needs and for occasional sale to Europeans engaged in mining ventures, etc., in the country.

After the removal of the native population from the concessions to the land delimited as native areas—*i.e.*, approximately a third of the whole country—the position changed. The smaller amount of land available and the steady increase in the numbers of cattle were reflected in the decrease in fertility, with consequent difficulty in producing sufficient food crops for native needs. The persistent cereal cropping gradually exhausted the soil, and at the same time the witchweed parasite of these crops increased and still further reduced the yields. From this period dates the increase in the use of ploughs by natives. The estimate of ploughs owned by natives is given as 1 plough to every 10 adult male natives in 1914, increasing to 1 to every 2 at the present time.

The poor rainfall of the past seasons has made the agricultural position much worse and yields have become so low that the native,

from being self-supporting, has become an extensive purchaser of maize. The system of farming has been, and in general still is, that of continuous cereal cropping. Other crops, cowpeas, nhlubas, green gram, sweet potatoes and sesame, are grown in small quantities, but not in sufficient amount to be of any rotational value. The land is poorly ploughed, and planting consists in broadcasting the seed in front of the plough. The plant population is in general too dense, due partly to laziness and partly to the native's disinclination to uproot anything of value. Practically no use is made of the considerable amounts of kraal manure available, and cultivation of the crops is very inefficient.

In view of this existing primitive state of agriculture it is obvious that any attempt to introduce a new crop such as cotton must be embodied in a wider scheme aimed at the teaching of better agricultural methods, the introduction of suitable rotation schemes, and improvement in the quality and the variety of the crops grown. With the gradual increase in yields through improved seed and cultural methods less land and labour will be required for the production of the essential food crops, and more will be available for the growing of revenue-producing crops such as cotton.

With these objects in view plots planted in the native areas were laid out to act as demonstrations in the growing of cotton and in the principles of crop rotation, and to introduce crops such as groundnuts and others of a semi-permanent nature, such as cassava and pigeon-pea. To oversee these plots and to stimulate the interest of the cultivators, a small staff of trained natives was employed. The presence of these plots and the visits of the native demonstrators led to considerable interest in cotton, and in the following year a number of natives asked for seed and for advice in the cultivation of the crop and, though the late rains prevented planting in some areas, the 1933-34 season saw 25 native cotton growers. As was expected, yields were not high, but the growers were well satisfied with the cash return. The success of these growers stimulated further interest and, as a number of additional demonstrators had been employed by the Swaziland Government, it became possible to open up areas further afield. In the present season the number of growers has increased substantially, as is evidenced by the seed issues in the area north of the Usutu, of which 40 per cent. was taken by natives. In addition, some hundred natives, who for reasons of delayed rains, etc., have not planted cotton, received seed of other crops and advice on methods of cultivation. Reports from the demonstration centres point to an increase in the number of cotton growers in the coming season, and in some areas the

effects of these demonstrations and the advice given are already apparent.

Considering the low state of agricultural development of the Swazi and his distrust of any interference by Europeans, the position is very satisfactory, and though development may be slow it should be progressive and ultimately lead to a considerable cotton production. To meet the need for additional demonstrators, Swazi youths from the various schools in the territory are receiving a course of agricultural training at the Swazi National School. At the request of the Swaziland Administration arrangements have been made for candidates for these posts to spend a final year at the Corporation's station in order to familiarize themselves with the various crops and agricultural operations, and with the duties which will be theirs in the native areas. Owing to the broken nature of the country, with cultivation and small kraals in scattered valleys and ridges, supervision of demonstrators will become increasingly difficult and, for the efficient working of the scheme, additional European supervisors are needed. In addition to the native areas, about one-eighth of the total number of natives live and cultivate on European land, and their presence ensures a supply of labour to the owner of the land, and in some cases a money rental is charged. To meet the money requirements for tax payments and land rental an increasing number of these native tenants are becoming interested in the cotton crop.

Transport and Handling of the Crop.—Swaziland has no railway, but terminal stations of the South African railways exist at several points at or near the border, giving communication with the ports at Lourenço Marques and Durban and with Johannesburg. A service of large motor-buses was inaugurated by the South African Railways Administration, linking up the country with Gollel in the south and Breyten in the west. The service has lately been extended and now covers practically all the main roads of the country. Though transport is now available, it is costly compared with rail freights and restricts the marketing of low-priced agricultural produce. Even with the comparatively high price for weight of cotton lint, freight is a considerable item, the extra cost to railhead being over ¼d. per lb. It is possible that increase of traffic through augmented production of exportable crops, with its natural accompaniment of increased consumption of imported articles, may lead to a cheapening of freight rates.

North Swaziland is served by a ginnery at Bremersdorp, but cotton grown south of the Usutu River is handled, owing to freight considerations, by ginneries around Durban. A ginnery was in action

until a few years ago at Empangeni, on the Gollel-Durban line, but this has since closed down. The small ginnery at Bremersdorp has a present capacity of 10 bales (500 lbs.) of lint per day, but has no machinery for the pressing of high density bales. It is estimated that the installation of such machinery would mean an ultimate saving to the grower of around ½d. per lb. of lint, but the present production does not warrant the installation of further plant. A considerable rise in the amount produced would render this possible, with consequent benefit to the grower. Most of the growers are members of the local co-operative association, which is affiliated to a central organization. This organization and the method of disposal of the crop has been described by Mr. Hesse in an article in the Review of October, 1927. With the small native producer a different system had to be arranged. At the start of the scheme of cotton growing amongst natives it was realized that the industry could best be encouraged by the Government handling the crop, and the following system has been adopted. At planting, seed is issued to growers and a record kept of the individual amounts given out. At harvest, the cotton, which has been picked in two colour grades, is weighed, either at the ginnery or at centres in the various areas, and the grower receives a "chit" giving his name and the weight of cotton of each grade. This he takes to the nearest Government office and receives the amount due to him—the amounts being based on a previously settled price for each grade. From this total is deducted any amounts owing for seed, sacks, or transport of the seed cotton to the ginnery. After ginning, the lint is sold on behalf of the Government and any surplus over the amounts given to growers is then distributed. The system works satisfactorily and is desirable at least until the industry has been firmly established.

Experiment Stations.—Two stations have been maintained by the Corporation—one at Bremersdorp in the Mid Veld, at an altitude of 2,200 feet, and the other in the Low Veld to the west of the Lebombo range. The Mid Veld station is in an area of fairly high and reliable rainfall and in general good cotton yields have been obtained. The Low Veld station receives a considerably lower and more erratic rainfall and suffers more from losses by insect pests. It has been felt that valuable assistance to the work could be obtained from a sub-station situated to the north of Bremersdorp, and during the past season a portion of Crown land adjoining the Black Umbelusi River was placed at the Corporation's disposal by the Swaziland Government. The area surrounding this station includes the White and Black Umbelusi and Komati Valleys and is suited to cotton growing. The rainfall is not so precarious as at the Ingwavuma station, and the site selected

is in the centre of an area with a high population of native and coloured people.

The work of the stations has been concerned with field trials of a large number of strains selected from U.4, and with cultural experiments designed to ascertain the optimum spacing, method of planting and time of thinning of the cotton crop. In addition, fertilizer and rotation investigations are being carried out, and the results of all the foregoing trials have been given in the Annual Reports from Experiment Stations. Some of the investigations, such as spacing, will be discontinued for the present, as sufficient evidence is available to justify recommendations suited to existing practice amongst the European farmers. The native, with his system of hand planting and hand hoeing, presents somewhat different problems, and investigations of planting methods, etc., suited to his needs will be continued. Other points receiving attention are: (*a*) the most suitable method of utilizing the large amounts of kraal manure available; (*b*) the effects of the cotton crop on the following maize and kaffir corn crops. One of the main problems in the Low Veld has been the difficulty experienced in getting the cotton crop established, owing to the poor rainfall distribution and to the prevalence of dust storms in the early part of the season. Methods designed to concentrate any small falls of rain that may be received and to protect the seedlings from winds will be put into practice on the Low Veld station.

Since the mass distribution of U.4 seed to farmers in the 1929-30 season this has been the variety universally grown in the country, and, owing to the recent abnormal seasons, no single re-selected strain has been released for general distribution to replace the original bulk. The system has been to make a new bulk of the U.4 strains which proved most generally successful on the experiment stations, and to issue this seed to certain growers. In the following season the seed from the ensuing crops is kept separate at the ginnery and is used for the bulk plantings in the following year. Last year's report from the local ginnery shows that the cotton from this admixture of selected strains gave a ginning outturn 2½ per cent. higher than the remainder of the crop which was grown from the original U.4 bulk.

Insect Pests.—Since the introduction of U.4 cotton, jassid has not been a factor in reducing yields, but very considerable losses are sustained from both American and red bollworms, and in some areas from stainer. With the additions to the staff in Swaziland, work on the insect pests of cotton has been very considerably increased and the lines of work are those inaugurated at Barberton. The system of survey has been detailed in the Reports from Experiment

Stations and elsewhere, and in general it consists of a continuous recording of the activity of the various insect pests on cotton and on other host plants. The known alternative food plants of red bollworm in Swaziland are *Cienfuegosia* spp. and a species of wild cotton, while the American bollworm has an extremely wide range of both cultivated crops and weeds. The cotton stainer has been found on *Sterculia* spp. and on various species of Hibiscus. In addition to the pests mentioned above, there has been an increase in the number of outbreaks of attacks by the *Syagra rugifrons* beetle, which in the adult stage feeds on the leaves of the cotton plant and in the larval stage attacks the plant roots. In the past, outbreaks have been attributed entirely to the presence of standover cotton or to the planting of cotton in successive seasons on the same land. During the present season, beetles, provisionally identified as the Syagra beetle, have been found on a species of Hibiscus and on Cienfuegosia.

ROTATION CROPS.—Reference has been made earlier in this article to the necessity of finding systems of rotation suitable to the various areas and to the two sections of the agricultural community—European and native. The former is concerned with the cultivation of crops which can find a cash market or can be profitably utilized as cattle food, while the main concern of the native is to ensure his food supply. Maize and kaffir corn are grown extensively, and work on the stations has included the production by introduction and selection of types suited to the local conditions. The type of maize in general cultivation is suited only to the areas of favourable rainfall, and a white flint type which has been issued from the station is proving increasingly popular. Kaffir corn is the staple crop of the native, and the types in cultivation are mixed and late maturing, and are subject to attack by Aphis. A dwarf variety which matures much earlier, and which has proved capable of withstanding poor conditions and Aphis attack, has been bred on the station. The demand for this is keen, and stocks are being bulked for issue to growers. One of the worst features of the cereal crops is the increase in spread of the witchweed parasite, and investigations of control measures are being continued.

With regard to other crops, particularly legumes, attention has been drawn to the small part these occupy, more especially in the native agriculture. A wide range of legumes has been tried at the stations and the most promising are groundnuts, soya and tepary beans. In the past these products have been difficult to market profitably, but the growing tendency amongst European farmers to

grow feed for cattle affords another outlet for these crops. The development of improved farming methods among the native population will lead to an increase in the amount of this type of crop, and groundnuts and tepary beans should make a useful addition to the present food crops.

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LOCUSTS AND A RATIONAL ANTI-LOCUST POLICY

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THE layman's conception of locusts is that of insects which suddenly appear from somewhere in enormous swarms darkening the sky, and disappear again leaving bare ground in place of rich pasture and abundant crops. The mysterious origin of the swarms, their enormous size and the countless numbers of individuals of which a swarm is composed, all create an impression of utter impossibility of ever defeating this pest. It is exactly this spirit of hopelessness which is typical of the anti-locust policy over practically the whole world. In the great majority of countries subject to periodical locust ravages nothing is ever undertaken to prevent the appearance of swarms, and no attention is paid to locusts until the invasion reaches such an extent that the battle against it can be counted as lost before it begins. The organization for defence is designed only to save the crops and to minimize the losses. Enormous sums of money are spent on such defensive measures, and not always with success. In the Argentine, for example, the amount spent on locust control during the period 1897-1933 totalled over £11,000,000. This means that more than £300,000 on the average were spent every year, and in some years the expenditure rose to nearly a million pounds. In the Union of South Africa £1,125,000 were spent on locust control during the years 1920 to 1928, or £125,000 annually, and in the year 1934 alone the cost was £1,400,000. To these expenses must be added the cost of tens of millions of working days spent in fighting locusts by the population, who are obliged to do so by law. It should be clear that the economic aspect of the locust problem is a very serious one.

An objection can be made that locusts are not a universal pest, but occur only in some countries. As a matter of fact, however, on every continent there are only a few countries which are safe from these pests. In most of Europe, it is true, no locust swarms have occurred for nearly a century, but the Mediterranean countries are still suffering from them regularly, and a heavy outbreak is developing

in southern Spain at the moment. On the south-eastern fringe of Europe, in the steppes of Russia and the Caucasus, locusts are a regular pest. Turning to Asia, the whole southern half of this enormous continent, except the highest mountains and plateaux, is ravaged by locusts from time to time; and the northern grasslands of Siberia are subject to a regular plague of grasshoppers, which are the nearest kin of locusts. The continent of Africa is wholly in the danger zone, and the devastations caused there by locusts during the last few years are well known. In South America, Argentina is not the only country that has to pay a heavy tribute to locusts, and other states of that continent suffer no less heavily. In North America, as in Siberia, locusts give place to grasshoppers, but the problem of their control is essentially the same. The smallest and the remotest continent of Australia, although still little developed agriculturally, has already had several warnings of impending catastrophes, and only last year wide areas were devastated by locusts.

Naturally, the species of locusts are not the same in every continent and country, and their habits vary to some extent, but the essential features of the locust problem are amazingly similar everywhere.

The first characteristic of the problem is that the areas covered by locusts in their migrations are very much greater than in the case of most other insects. As a result, swarms arising during a given season in one country may soon spread beyond its borders and invade distant territories. An excellent example is offered by the movements of the Migratory Locust in Africa during the recent outbreak. It is now established beyond any doubt that the first small swarms of this locust arose about 1926 in the inundation areas of the Middle Niger, south-west of Timbuctu, in the French Sudan. Spreading gradually and increasing in number and size after each breeding season, the swarms soon invaded the whole of West Africa, spread into the Anglo-Egyptian Sudan, then swept into East Africa and crossed the continent once again from Rhodesia into South-West Africa. These developments may sound almost fantastic, but they have been followed year by year, and it took only five years, during which ten successive generations were produced on the way, to accomplish a double crossing of the continent and to invade the greater part of it.

Similar extensive wanderings of locust swarms have been repeatedly observed in other countries, and their complete disregard of international boundaries suggests the futility of ever finding a solution of the locust problem, except on an international basis.

The necessity of international co-operation in locust control has often been stressed, but the type of co-operation usually visualized is as useless for the real solution of the locust problem as the sporadic defensive measures practised in each country. It is often suggested in the countries spending large amounts on locust control within their own borders, that a similar energetic anti-locust policy in every other country would lead to a speedy and complete extermination of the pest. This is a complete fallacy, since the numbers of swarms, to say nothing of individuals in them, are so great that a simple calculation should show the impossibility of completely exterminating them. Indeed, if a pair of locusts produce only a hundred offspring (and this is a most conservative estimate) the destruction of even 98 per cent. of the offspring would result in the number of locusts remaining the same as before. There is no doubt that this percentage of destruction is practically unattainable, except in the most densely populated and highly civilized countries. When a continent like Africa has to be cleared of locust swarms wandering over its deserts, dense bush and swamps, it cannot be hoped that success can be achieved even by a universal anti-locust campaign. The cost of such a campaign would be, of course, expressed in astronomical figures, and in some of the most dangerous areas there will not be found sufficient man-power to carry it through.

Clearly, other strategical schemes have to be devised to deal with this formidable pest. A sound basis for such schemes has been provided by some results of the more recent studies on the problem. We have seen already that in the case of the Migratory Locust the invasion involving the greater part of the continent of Africa has originated in a single relatively small area. Again, it is almost certain now that the swarms of the dreaded Red Locust, now invading practically the whole of Africa south of the equator, arose some years ago in two or three small areas in Northern Rhodesia and Tanganyika Territory. In the case of the Desert Locust, which constitutes a grave menace to crops and most particularly to cotton, in West Africa, the Sudan, Iraq and India, there is every reason to hope that the original sources of its outbreaks will be discovered before long, some of them being already known. The swarms of the Moroccan Locust, a dreaded pest of crops in all Mediterranean countries, in Iraq, Persia and Turkestan, may spread over whole provinces, but the swarms have their origin in narrowly defined areas, with peculiar soil and vegetation conditions. No comparable investigations intended to discover the original sources of swarms have been organized in other parts of the world, but even the incomplete knowledge in

our possession of the locust problem there, leaves no doubt that the same state of things will be found everywhere. Outbreaks of locusts always commence by the formation of a few swarms in relatively small areas, with peculiar natural conditions, and the invasion then gradually spreads over the whole country and beyond its borders.

The importance of this general finding for devising a sound anti-locust policy is not difficult to understand. It means that once the *outbreak centres*, as they are called, are located, it would become a relatively simple matter to keep them under constant observation, and to suppress the incipient outbreaks in their earliest stages, when the swarms are neither large nor numerous. This policy would result in effective *prevention of invasions*, which is, of course, vastly better than the purely defensive policy which has been, and still is, practised in all the countries.

The cost of the preventive policy is certainly well under that of controlling, or attempting to control, the swarms which have spread over the whole country, while in addition all losses to crops would be eliminated.

The difficulties in organizing a preventive control of locusts, as outlined above, are mainly psychological and political. It is a common human failing that a danger is seldom realized until it is too late, and it is easily forgotten when it is past. Since locust swarms appear only periodically with clear intervals of several years, it is not easy to persuade those whom it concerns to spend even a small amount in order to prevent an invasion when there is as yet no sign of it. Once the swarms appear and a panic sets in, the costs are not counted, and money and labour are wasted in the hopeless struggle against an overwhelming enemy. When the swarming period is over a victory is proclaimed, and it becomes practically impossible to convince those in authority that the respite is only temporary and a new invasion is certain to come within a few years. It finally comes "unexpectedly," and the whole story begins all over again.

Until recently, this short-sighted policy had its justification in the insufficient knowledge of the habits and the sources of locust swarms. Now, as we have seen above, it has been convincingly demonstrated with regard to several locust species that the policy of prevention can be based on the soundest possible foundation.

The first step towards such a policy in the case of each species of locusts would be a thorough investigation of the course of invasions, in order to discover the outbreak centres. Owing to the disregard of all boundaries by locust swarms, these investigations must be inter-

national in their scope and cover the whole territory over which the particular locust species can migrate. It is exactly on this basis that the locust investigations in Africa and Western Asia have been organized by the British Government. The countries within that immense territory agreed to submit monthly reports on the locust situation to the Imperial Institute of Entomology, London, which is recognized as the International Centre of Anti-Locust Research. These reports, accompanied by maps showing the breeding places and the movements of swarms, are carefully studied, and general maps and reports are prepared. These summary reports permit the Institute specialists to discover the main lines and directions of migrations, as well as the areas suitable for breeding. By following the reports back to the earliest stages of the invasion, it proved possible to trace the swarms to their original sources or the suspected outbreak centres.

The next step was to investigate these supposed outbreak centres on the spot and to define them more closely. Several entomologists entrusted with this task were sent by the British, French, Indian and Belgian Governments to carry out these investigations. Some areas have already been surveyed and important practical conclusions have been reached, but the territories to be studied are very extensive and some of them difficult of access. The work is, therefore, not yet accomplished, though the end can be visualized within the next few years.

With regard to one locust, however, the Migratory, the task of preliminary surveys can be considered completed, and the problem of that locust is already ripe for a practical organization of preventive control. It is, however, one thing for the scientists to show the rational way to the solution of a problem, and quite another to hope that the necessary steps will be taken to reach it. In this particular case the difficulties in the way of practical steps are aggravated by the necessity to create an organization which would be international in its scope. When a single outbreak area presents a source of danger to the whole continent, it is only natural that all countries should take an active part in organizing the permanent control in that area. The task of creating such a permanent organization appears a difficult one, but it belongs to the sphere of politicians, not of entomologists.

The case of the Migratory Locust in Africa is, however, an extreme one. With some other species the problem is less formidable, since they are more localized, and often an outbreak area supplies locust swarms only to a single country. Such is the case, for example, with the Moroccan Locust, a notorious pest in some cotton-growing

countries. The present writer's investigations in Turkey and Iraq, and M. Pasquier's detailed studies in Algeria, proved definitely that this locust can be easily kept under control in a single country. Indeed, an organization for the supervision of outbreak centres is already functioning in Algeria, and there is every reason to think that this means the end of invasions of that country by this locust. The cost of the permanent organization, which should be counted as an insurance premium against invasions, is very slight, compared with the periodic expenses of controlling the invasions. Unfortunately, other countries, even where the preliminary research work has been done, still prefer the time-honoured system of waiting for swarms to begin their ravages before anything is done to control them.

To conclude, the investigations and the experience of the last few years go a long way to prove that the great locust problem is not impossible of solution. This solution can come, however, only through a broad organization of research into the original sources of outbreaks. The investigations should supply the essential facts for developing a comprehensive preventive policy in the natural area of each locust species. In both stages of work, the success depends on an effective international co-operation, and on an efficient central organization. Given these two conditions, the locust problem will soon lose its tremendous importance, though a constant vigil will be necessary in the outbreak areas.

It is a hopeful sign that the idea of international co-operation in anti-locust research designed to develop a preventive policy is now finding an almost universal recognition. This policy has been fully endorsed by an international locust conference held in London in 1934, at which thirteen countries were represented. At the next conference, to be held at Cairo in 1936, it is hoped to extend the international anti-locust schemes to all the countries of the world suffering from this oldest and greatest enemy of agriculture.

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COTTON AND RAYON

BY

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A SPEAKER at the recent Royal Academy Banquet observed that all art now seemed to be in a state of flux. One has only to look around, however, to realize that the truth is bigger than this and that civilization itself is now in a state of flux. Vast political, social, economic, and scientific upheavals have attended and followed that international earthquake the Great War. But earthquakes mark crises in unceasing movement, and they serve to remind us that motion is the sign and change the law of life. *Plus ça change, plus c'est la même chose.* And the things that all of us are most profoundly concerned about are the *rate* of change and the *direction* of change. Apt illustrations of these reflections are furnished by the actual and relative productions of cotton and rayon in the past and present, and from these we are led naturally to a speculative interest in their probable fields of utility in the future.

King Cotton has had a very long reign. Since prehistoric times cotton appears to have been the textile fibre most used for clothing in India, Mexico, and South America, and possibly in parts of Africa also. And whereas until the Industrial Revolution the most important textiles in Europe were woollens and linens, and in the Far East silks and woollens, the domain of cotton has since extended to these and all other parts of the world. Unfortunately, no statistics are available to show the productions of cotton and other fibres earlier than the seventeenth century, and so no comparisons are possible between the crops of early and modern times; but in view of the tendency of the world population to increase, it is only natural to suppose that productions were still less in early times than in the period when records began to be made.

The purpose of the present article is to discuss some outstanding facts relating to the course of development of cotton and rayon production in order to form some conception of the changes likely to occur in these in the future. Only a passing reference will be made to current changes in cotton production, as these have been fully and adequately discussed in recent issues of this Review by J. A. Todd.

In the first place attention may be directed to the change that took place in the production of cotton before and after the Industrial Revolution. This peace-time revolution in England affected its cotton industry more than any other. Previously in this country cotton had been a mere stripling among the textile fibres, with wool the "big brother." As Table I. shows, even at the end of the eighteenth century

TABLE I.—COTTON, WOOL, AND FLAX: COMPARISON OF WEIGHTS CONSUMED IN GREAT BRITAIN FROM 1697 TO 1882.

	Cotton (*Millions of Lbs.*).	Wool (*Millions of Lbs.*).	Flax (*Millions of Lbs.*).
1697 ..	2·0	—	—
1720 ..	2·0	—	—
1741 ..	1·6	—	—
1751 ..	3·0	—	—
1764 ..	3·9	—	—
1771–1780 ..	5·8	—	—
1781–1785 ..	15·3	—	—
1786–1790 ..	25·4	—	—
1798–1800 ..	41·8	109·6	108·6
1829–1831 ..	243·2	149·4	103·8
1859–1861 ..	1,022·5	260·4	212·0
1880–1882 ..	1,424·6	448·6	273·8
1912 ..	2,482·0	—	—

the weight of cotton consumed was less than half the weight of either wool or flax, but 30 years later the consumption of cotton had multiplied sixfold, while that of wool had advanced less than 40 per cent., and that of flax not at all, and so cotton had then well outstripped its competitive fibres, going still further ahead with giant strides in the succeeding 50 years. Table II. shows that in value also the cotton

TABLE II.—COTTON, WOOL, AND FLAX: COMPARISON OF VALUES (MILLIONS OF £'s) OF FABRICS AND YARNS PRODUCED IN GREAT BRITAIN IN 1783 AND 1882.

	1783.	1880–1882.
Cotton	1	107
Wool	17	53
Flax	4	18
Total	22	178

fabrics and yarns, from occupying a bad third place in 1783, had easily surpassed their rivals a hundred years later; and Table III., dealing with the values of exports, tells exactly the same tale.

TABLE III.—COTTON, WOOL, AND FLAX: COMPARISON OF VALUES OF EXPORTS (IN THOUSANDS OF £'s) FROM GREAT BRITAIN.

	Cotton.	Wool.	Flax.
1697	6	—	—
1701	23	2,000	—
1720	16	—	—
1741	21	—	—
1751	46	—	—
1764	200	—	—
1783	360	3,700	700
1790	1,662	—	—
1798–1800	5,088	6,846	1,010
1829–1831	18,077	4,967	2,138
1859–1861	49,000	15,041	6,119
1880–1882	76,816	21,377	6,907
1921	178,665	59,491	18,519

This great cotton industry was not developed without experiencing grave difficulties in the supply of cotton. Prior to 1700 the imports

of cotton into England were from the Levant, but in 1787 this was only one of the sources (as indicated by Table IV.), equally important at that time being the British West Indies and various foreign settlements in

TABLE IV.—COTTON IMPORTS INTO GREAT BRITAIN, 1787.

	Million Lbs.
British West Indies	6·8
French and Spanish South America	6·0
Dutch South America	1·7
Portuguese South America	2·5
Isle of Bourbon (Réunion Isle)	0·1
Smyrna and Turkey	5·7
	22·8

South America (chiefly Guiana), and also the Isle of Bourbon (420 miles east of Madagascar), from which came in small quantity the most exquisite fibre of the time. Cotton from India proved unsatisfactory to the spinners of that day, and there is no doubt that the development of the United States cotton belt soon after this date, accelerated as it was by the invention of the saw gin by Eli Whitney in 1793, eventually proved the salvation of the young English cotton industry. How the American cotton crop has grown will be clear from Table V.,

TABLE V.—DEVELOPMENT OF AMERICAN, EGYPTIAN, INDIAN, AND EMPIRE COTTON CROPS.

(MILLIONS OF LBS.)

	American Cotton Crop.	*Indian Cotton Crop.*	*Egyptian Cotton Crop.*	*British Empire Cotton Crops (excluding India).*
1790	1	—	—	—
1795	8	—	—	—
1800	37	—	—	—
1805	73	—	—	—
1810	89	—	—	—
1815	105	—	—	—
1820	117	—	—	—
1825	266	—	16	—
1830	366	—	21	—
1835	531	—	21	—
1840	674	—	16	—
1845	903	—	34	—
1850	1,068	—	36	—
1855	1,610	—	52	—
1860	1,920	—	60	—
1865	1,047	—	212	—
1870	2,012	—	135	—
1875	2,151	—	209	—
1880	3,178	—	317	—
1885	3,184	—	276	—
1890	4,281	—	412	—
1895	3,573	—	522	—
1900	5,061	1,181	538	—
1905	5,287	1,366	590	—
1910	5,804	1,556	750	—
1915	5,596	1,495	476	30
1920	6,720	1,440	597	43
1925	8,052	2,486	789	144
1930	6,966	2,090	819	165
1931	8,548	1,603	629	152
1932	6,501	1,862	491	193
1933	6,523	1,988	849	205

based on tables given by Todd in his " World's Cotton Crops " and in articles in the EMPIRE COTTON GROWING REVIEW; this Table also shows how the Egyptian, Indian, and Empire crops have developed. The world position of cotton supply, now a regular feature of this Review, was largely a matter of conjecture even in the early nineteenth century.

In 1835-1836 the supply (exclusive of China) was estimated to be 686·8 million lb., made up as follows:

	Million Lbs.
United States of America	442
India	136
Brazils and the West Indies	68
Levant	26
Egypt	17
	689

In 1882-1883 the world's cotton crops amounted to 5,030 million lb., and in the last six quinquennia since 1902 the average annual crops have been as follows:

	Million Lbs.
1902–1907	9,119
1907–1912	10,219
1912–1917	11,772
1917–1922	9,963
1922–1927	12,208
1927–1932	13,434

And in the last three individual years the world's crops have been:

	Million Lbs.
1931	14,138
1932	12,204
1933	13,397

These world cotton crops may be compared with those of some other textile fibres for 1929 in millions of lb.: Wool, 3,620; jute, 3,500; silk, 108.

Taking a broad view of the situation, one notes that the average world crop in the last quinquennium (1927-1932) is much higher than for any previous one, and it therefore does not appear that it has reached anything like a stationary position. Acreage restriction in America has resulted in a notable reduction of its crop, and a consequent contraction of the world crop since 1931, though the deficit in the American crop has to some considerable extent been made good by larger crops elsewhere, particularly in Brazil, where the crop for 1934-1935 is estimated to reach nearly 1,600,000 bales of 478 lbs. The great increase in the "outside growths," to which Todd has repeatedly drawn attention, is evidence of change in the geographical distribution of the world's cotton crops, proceeding alongside the change in size.

The great increase in the size of the world's cotton crops in the past 150 years has been accompanied by an equally large fall in the price of cotton yarns, which may be illustrated by the following prices of 100's yarn in various years since 1786:

	Prices of 100's Cotton Yarn.		
	s.	d.	
1786	38	0	per lb.
1790	30	0	,, ,,
1794	15	1	,, ,,
1800	9	5	,, ,,
1805	7	10	,, ,,
1829	3	2	,, ,,
1935	1	11	,, ,,

We may now turn our attention to the production of rayon, the invention and development of which constitutes one of the most

remarkable features of modern times. Table VI. tells in figures the history of the increase of world rayon production, and of the accompanying reduction in the price of rayon. It will be observed that the increase in the production has actually been tenfold in the last 12 years; the increase in the preceding 20 years had been somewhat less rapid and had not caused any concern to the older textile industries, no doubt because the total rayon production even in 1922 did not amount to as much as a half per cent. of the world's cotton crops. But the potentialities of the new fibre made from wood pulp were manifest, and the present writer, at the Textile Institute Conference of that year at Blackburn, drew attention to the significance of the development of the new fibre and its meaning to the cotton industry, and speculated whether its importance might in time become so great that the Government would be impelled to institute an Empire Timber Growing Corporation on the same lines as the then recently formed Empire Cotton Growing Corporation. The spectacular increase of the world rayon production during the past 12 years has surpassed all expectations, amounting as it does now to over 5 per cent. of the world cotton crops, so that if production should continue to increase at the same rate during the next 12 years, it is clear that in 1946 we should have to contemplate a world rayon production of over half the size of the present cotton crop. But is there any reason to think that some check may occur to the present rapid expansion in the production of rayon? The answer to this question is twofold: it depends on (1) the price of rayon and (2) the market capacity for absorbing the production. Of course, these two things are not unrelated. Take the price question first.

TABLE VI.—RAYON PRODUCTION AND PRICE.

	World Rayon Production (Million Lbs.).	*Prices of 150 Denier Viscose Rayon in U.S.A. ($ per Lb.).*
1891	0·03	—
1896	1·25	—
1900	2·2	—
1901	3·3	—
1903	6·6	—
1905	11·1	—
1907	14·3	—
1911	18·7	1·85
1914	26	2·00
1919	40	5·50
1920	50	6·00
1921	65	2·75
1922	79	2·75
1923	100	2·75
1924	141	2·00
1925	190	2·00
1926	225	1·65
1927	310	1·50
1928	385	1·50
1929	455	1·30
1930	443	1·15
1931	496	0·75
1932	515	0·65
1933	645	0·55
1934	795	0·55

One notes from Table VI. that the price actually rose from 1911 to 1914, and in the boom year, 1920, reached its peak. Since then the price has been greatly reduced in a series of steps, and at the present time is *not one-tenth* of what it was in 1920. If this fall of price be compared with that of the 100's cotton yarn it will be observed that after 1786 it was 40 years before the price of the cotton yarn fell to one-tenth, and at the present time, more than 100 years later, the price of the cotton yarn is nearly two-thirds of what it was in 1829. Superficially, judging purely by analogy, therefore, it would appear that the tremendous fall in the price of rayon is not likely to continue; certainly the law of diminishing returns must be expected to operate obtrusively at some point, and there is reason to think that that point is near at hand, if it has not indeed already arrived.

This conclusion is based upon a consideration of the factors entering into the cost of rayon production. Viscose rayon is the cheapest rayon to produce, and this requires bleached wood pulp as its cellulosic raw material, which has to be treated by large quantities of caustic soda and carbon disulphide and other chemicals. The cost of all these raw materials in Western countries is about the same per lb. of rayon as that of Middling American cotton. World economic factors tend to keep these costs in step, though naturally local variations and sectional processing improvements might easily cause some divergence; thus in Japan the cost of these raw materials is said to be only two-thirds of the cost in the West. Labour and overhead costs fall within an entirely different category. These obviously depend largely upon the country of manufacture, though it may be noted that where they are low for rayon they will also be low for cotton. It is no doubt on this account that Japanese competition in rayon goods is no less insistent than in cotton goods. In Western countries the labour and overhead costs are very much higher for rayon than for cotton except in very fine counts. In fact, it is stated that, in the case of viscose rayon, raw materials account for only 25 to 33 per cent. of the cost of production; in the case of coarse singles cotton yarns the cost of the raw material forms a much higher proportion. As will be seen from Table VII., at the present day it is only when a fine yarn (100's) spun from super-combed Sakel has been doubled, gassed and mercerized in addition, that its price approaches that of rayon, and even passes it when due allowance is made for the 6d. duty included in the price of the rayon.

In Japan, as a result of low labour costs—wages being no more than 10 per cent. of what they are in England—the disparity between cotton and rayon yarn prices is much less, and it has been stated

recently that the firms in that country expect to market standard rayon yarn as cheaply as 40's cotton yarn. But so rapid has been the expansion of the rayon industry in Japan that fears are entertained there that it is heading for a crash.

TABLE VII.—PRICES OF "STAPLE FIBRE," RAYON, AND COTTON YARNS (PENCE PER LB.) DECEMBER, 1934.

Single Counts (Carded).	Twofold Counts.	Mule Twist. American Cotton Singles.	Mule Twist. Sakel Cotton. Singles.	Mule Twist. Sakel Cotton. Twofold.	Fibro (Staple Fibre) Small Tubes.*	Viscose Rayon Pirn Weft.†
20	2/40	9	—	16½‡	22¾	32
32	—	10¼	—	—	23¾	37¼
38	—	10¾	—	—	24¼	39¾
40	2/80	—	14⅛	26¼	24¾	—
44	—	12¼	—	—	25¼	41½
50	2/100	—	15¼	31¾	26¾	—
54	—	13½	—	—	27¾	46½
60	—	—	17	—	28¾	—
70	—	—	18¼	—	32¾	52¼
80	—	—	19¾	—	—	—
100	—	—	23¼	—	—	—
—	2/100's gassed and mercerized super combed Sakel	—	—	44½	—	46¼

Spot Prices (pence per lb.) at Liverpool of Raw Cottons on November 30, 1934.

F.G.F. Sakel	9·00
Middling American	6·96
Superfine Oomra No. 1	5·07
Superfine Bengals	3·77

* Price includes 3d. per lb. duty. † Price includes 6d. per lb. duty. ‡ Uppers.

Leaving the question of price on one side for the moment, we may now consider the question of markets. In view of the dominant position of cotton as a textile it is clear that the introduction of rayon into the textile markets may easily assail this position. The further question therefore arises: From their nature, to what extent are cotton and rayon competitive, and to what extent complementary? The outstanding advantage of cotton in the past has been its cheapness in coarse counts and its strength and regularity, and also its lustre when mercerized. Rayon excels in lustre and regularity, but has suffered in the past from lack of strength, especially when wet; there is also a very distinct difference in feel between goods made from the two fibres, which in some cases is favourable to cotton but often to rayon. Evidently, therefore, there are distinct fields in which either may be preferred to the other. It is interesting to note that the introduction of rayon has in some respects been similar to that of cotton itself 150 years earlier. Before the Industrial Revolution the small cotton spinning industry did not make yarns for warps but only for wefts, and where cotton was used it was in a union cloth as weft with a linen warp. So, with the introduction of rayon, while its chief market was first in hosiery and in small proportions for decorative effects in

cotton goods, later it was commonly used as weft with cotton warps. And just as cotton warps were finally used following the success of Arkwright's water-frame, so improvements in rayon processing have led to the supply of rayon warps and the production of all-rayon fabrics.

Quite recently a still further development has taken place in the rayon industry—viz., the production of staple fibre, *i.e.* rayon fibres cut to a definite length. Staple fibre is commonly cut to a length of $1\frac{7}{16}$ inches for use on cotton spinning machinery, and already a number of cotton spinning firms have undertaken the spinning of this comparative new-comer. The staple fibre bears a duty of 3d. per lb., and as will be seen from the prices given in Table VII. it is possible to spin the staple fibre Fibro and supply it at a much cheaper price than the continuous filament rayon, though it is still dearer than the corresponding singles cotton yarn. Goods made from staple fibre have a distinctive and appealing character of their own, which is likely to cause rayon to encroach still further on the territory served by cotton; but from the cotton spinner's point of view this competition is not so disturbing, since his machinery can cope very adequately with such staple fibre. But it does, of course, reduce the quantity of cotton that is spun.

As already mentioned, the world production of rayon amounts at present to only 5 per cent. of that of cotton; this position has been achieved partly by the creation of a new market and partly in competition with the older textile fibres—silk, wool, and cotton. So far, therefore, the cotton trade has not felt any severe competition as a result of the increased production of rayon, but a further expansion of the production of the artificial fibre must inevitably cause it to make inroads on the cotton market. Is such competition likely to be most severe in coarse, medium, or fine counts? It would be unprofitable to consider here what is likely to happen in the remote future, but so far as the present time and the more immediate future are concerned, it is plain to see that much depends upon the conditions and costs of cultivation of the long-stapled as compared with the short-stapled cottons, and that irrigation works now necessary for the bulk of the long and fine cottons are expensive both in first cost and in maintenance.

As things are, superfine Bengals cotton costs less than half as much as Fully Good Fair Sakel, and the cost of production of coarse cotton yarns is much less than that of fine counts both because the raw cotton is cheaper and because labour charges are less; there is not the same proportionate reduction in the cost of production of coarse rayon

yarns compared with fine, so that competition between rayon and cotton would be expected to be most severe at first in the fine counts. This competition is accentuated for the very fine cotton yarns which are used almost entirely as twofolds, and which have to bear high labour charges both in spinning and in the additional subsequent processes of winding and doubling. In fact, according to Mr. R. A. de la Beaumelle, discussing in 1933 the effect of rayon on the French cotton industry: "The increasing popularity of rayon, the improvement in its selling-price, and technical progress which it has made, have made it a competitor of the doubled cotton yarn in almost every sphere of activity." At the present time the competition is in fact being experienced chiefly in the Egyptian yarn market, rayon having found particular favour in poplins, crêpes, high-class prints, and furnishing fabrics, while still being used in all classes of knitted goods. But for coarse and medium cotton counts, used as singles in the great bulk of the cotton trade, it would obviously be uneconomic, because unnecessary, to utilize the expensive long-staple cottons rather than the short staples. And in view of the service which is commonly demanded from the cloths manufactured from these yarns, it is highly unlikely that they will be seriously displaced by rayon goods for a long time to come. For these reasons the conclusion is reached that in all probability the demand for rayon will continue to expand, but at a rate which will tend to slacken; and that when the present economic depression shall have passed, the total world's cotton crops will also continue to expand to meet the needs of the general increase in the world's population.

Received May, 1935.

DRAINAGE IN THE SUDAN GEZIRA

An open letter from H. Greene, Chemist in charge of Soil Research in the Gezira, and M. A. Bailey, Controller of Agricultural Research, Sudan Government, to Dr. W. Lawrence Balls, C.B.E., F.R.S.

Dear Dr. Balls,

Your recent article in the January issue of this journal states in no uncertain manner that those responsible for the development of the Sudan Gezira have neglected the obvious precaution of installing an adequate system of drains. In consequence of this neglect both time and money have, you say, been wasted, field experiments have been vitiated by lack of drainage and must be done again, certain chemical and physical actions have been intensified since the land was put under irrigation and there has ensued a " serious injury to the credit of the district."

Your article so clearly suggests that you have before you proof of some rapid, progressive deterioration which has taken place in the Gezira area since it was brought under irrigation, that we are left wondering as to the source of your information, and can only conclude that the data at your disposal are either incorrect or, at any rate, not sufficiently complete to allow of correct interpretation.

In reply to your charge, we must point out that the soil is, on the whole, a fairly fertile one, capable under favourable climatic conditions of producing excellent yields of cotton and other crops—the yield of cotton in the present season is an excellent example. Secondly, we must say that a full and exhaustive study of any yield data obtained in this area has failed to provide any clear, indisputable evidence of progressive deterioration in the soil.

It should be noted that the possibility of soil deterioration and the desirability of carrying out reclamation experiments are immediately apparent to any student of soil conditions; these problems have been studied in the Sudan since 1911, when W. Beam wrote as follows with reference to the Gezira:

"The fact that too little attention has commonly been paid to the drainage of irrigated lands is a truism. When this lack of drainage results in the stagnation of the soil water—*i.e.*, insufficient aeration—sodium carbonate is almost invariably formed. Treatment with gypsum should be the first step in the correction of such a condition."*

Fourth Report of Wellcome Tropical Research Laboratories, Khartoum.

Our investigation of these problems is not yet complete. We are, however, in a position to say that drainage is so costly as to be almost impracticable on a large scale, and further that, as the outcome of about thirty years' work, certain other problems, which are mentioned below, now appear to be of greater immediate importance.

The question of cost requires some special comment at this stage. The economic conditions which prevail in this country and in, let us say, Egypt are entirely different.

If rapid and serious soil deterioration, due to any cause whatsoever, should occur in Egypt that country would be faced immediately with the prospect of averting the death, through starvation, of millions of its people, and, concurrently, its main source of revenue would have disappeared. Disaster and disintegration would result, and it is clear that the expenditure of enormous sums of money can be justified for the purposes of avoiding such a calamity.

In this country a similar problem does not exist, and will not begin to appear for many years to come.

The Gezira—of which only a definitely limited area can ever be brought under irrigation—is under-populated, and we have behind us the almost unlimited and at present largely undeveloped resources of rain cultivation.

What may be a vital necessity in Egypt may well be both impracticable and unnecessary in the Sudan.

I.—The Present Fertility and Future Prospects of the Gezira

Up to 1924-25 the Gezira Irrigation Scheme may be said to have existed only in embryo—from 1911 to 1921 the cotton area averaged less than 3,000 acres. After the erection of the Sennar dam new land was taken in at a rapid rate, the cotton area increasing from 80,000 acres in 1925-26 to a little under 200,000 in 1932-33 and being reduced somewhat thereafter owing to change of rotation. Throughout by far the greater part of the area now referred to as the " irrigated Gezira " the land has borne *only two or three crops of cotton.* It is usually found that the first crop taken from land not previously irrigated is specially good (*cf.* Joseph [1925], " Alkali Investigations in the Sudan," *J. Agr. Sci.*, xv., p. 407), but, apart from this effect, the two or three crops of the past ten years naturally provide no indication whatsoever of cumulative deterioration in cotton yield, and one is left wondering how and why the suggestion has ever arisen.

We have said that the crop obtained from virgin land in the Gezira is usually a specially good one. This might, perhaps, be interpreted as indicating that one single season's irrigation is enough to bring about marked soil deterioration. Closer examination of the available data, however, shows that there is no evidence that this is the case.

Actually, when, in the past, large new tracts of land were brought into the scheme, only one-third of the total new area was normally put under cotton in the first year. In the next year, *another* third of the new area came under cotton, but the land on which this second crop was grown was still " virgin " land in the sense that it had never previously been irrigated. Despite this, much of the original (first year's) superiority in yielding power was found to have been lost. This cannot be due to soil deterioration and must, presumably, reflect the effect of the penetration of pests and diseases into the new area: in other words, we are witnessing a " virgin area " effect rather than a " virgin soil " effect.

We have pointed out that the main Gezira area is too young to allow of any inferences being drawn from the yields obtained as to progressive changes in fertility. On the other hand, there is one small portion of the area (Tayiba estate) where cotton has been grown since 1911, and the yields there might be expected to show more progressive decline, if it were the case that irrigation has a markedly deleterious effect on the soil. The yield data have in fact been carefully examined from this point of view first by Joseph and more recently by Dr. E. M. Crowther of Rothamsted. We now await publication of Dr. Crowther's exhaustive investigations, but have already been informed as to the main outcome of his enquiries. Dr. Crowther has found that the fluctuations in yield level which have occurred in that area throughout its history are extremely closely related to the rainfall in the months of May and June preceding sowing and also to the rest of the rainfall in that season and to the total rainfall in the previous one. The residual variation in yield fails to show any significant progressive decline within the present period of observations.

It is to be noted that the properties of this heavy alkaline soil admittedly are such as would make it unworkable in a more temperate climate, and there is accordingly no inherent improbability in the view that variations in climate should have a marked effect on yield.

It may be presumed that the " May-June rain effect " is the expression of some change in the soil or its flora, as the cotton itself is not sown until the month of August, but the possibility of these light and infrequent showers assisting in the carryover of insect pests through the dead season cannot be entirely overlooked. Much of the adverse effect of heavy rain falling in the period from the beginning of August onwards may, however, be attributed with confidence to (*a*) the excessive spread and development of Blackarm; (*b*) the postponement of the date on which large portions of the area are sown (late sowing always resulting in reduced yields); and (*c*) the increase of weed-growth up to the point where it enters into active competition with the cotton.

To sum up, therefore: About 98 per cent. of the irrigated area has been under cultivation for too short a time to provide any

indication of decline in yield due to soil deterioration. Careful examination of the records for Tayiba estate, irrigated since 1911, shows that variations in cotton yield appear to be very largely determined by climatic conditions. Such a relation is not improbable in view of the nature of the soil and the presumed importance of the normally dry dead season, and in view of the observed direct effects of such rain as falls during the sowing period and the time of early development of the crop.

II.—Soil Investigations Bearing on Drainage

Beam's remarks (1911) on drainage have been quoted above. The possibility that deterioration of the soil may occur as a result of irrigation is further noted in papers by Joseph (1925), by Greene (1928) and by Vageler (1931). The subject is not one that could possibly escape the attention of any instructed person engaged in the study of Gezira soil, and has in fact been carefully studied both in the laboratory and in the field. The following account summarizes a part of the observations made.

Sawer's field trial with an open drain, quoted in your article, followed Beam's recommendations. The soil at the Khartoum North farm is—unlike that of the Gezira—an alluvial deposit showing great local variation in mechanical composition and other properties. The first test, employing heavy flooding of land immediately adjacent to part of the drain, gave favourable results; the soil apparently was much more permeable than other tracts traversed by the drain, which have at no time shown any sign of free drainage. This open drain has, however, been of use, for when once in three or four years the whole soil surface is under water as a result of heavy rain, this channel speedily carries the run off into the Nile, and cotton seedlings are found to survive their brief inundation. In the Gezira, also, similar arrangements have been made for carrying off surface water which would otherwise kill seedlings by inundation or delay sowing.

The reasons for doubting the practicability of under-drainage in the Gezira are as follows: At the Gezira Research Farm, Medani, the soil is a fair sample of the canalized area in respect to mechanical composition, permeability, salt content and so forth. Here a normal watering moistens the soil to a depth of two or three feet, while continuous flooding for two or three weeks moistens the soil to a depth of four or five feet. Only in the top foot is the moisture content raised sufficiently high to permit free drainage. To install drains at a depth of one foot would require a robust enthusiast; if the drains were placed at a more reasonable depth the loosened soil above them would, for a while, permit ready penetration of water, but we have no reason to suppose that this condition would be maintained. It seems much more likely that the soil would soon return to its normal compact condition and thereafter the drains, however efficient in themselves, would be almost cut off from water supplied in normal irrigation.

In discussing soil permeability in the Eastern Gezira, Greene (1928) described an experiment, carried out in feebly permeable soil, in which gypsum in amounts equivalent to none, 1, 4, and 10 tons per acre was applied to closely adjacent sub-plots each $\frac{1}{80}$ feddan in area. Reference to these results shows an almost complete lack of downward water movement during a period of nine months between two floodings, and complete lack of lateral movement of water between these small, contiguous sub-plots during the actual periods of flooding. It is impossible to ignore results of this character when considering the practicability of drainage as a field operation.

Certain other restricted parts of the Gezira are more readily permeable to water and would, perhaps, permit some degree of drainage. In these areas, however, water penetration and root development appear to be satisfactory. Such areas might possibly be chosen for the trials you suggest if further experience justifies such a course of action. In normal Gezira soil, normally irrigated, the practicability of drainage seems remote.

Your recommendations, however, envisage reclamation rather than normal irrigation. Repeated experiments have been made with a variety of soil improvers. These experiments were largely empirical, since the theoretical basis for such trials is incomplete. Our object was to increase the permeability of the surface soil by comparatively light applications of soil improvers and so allow water to reach and pass through the salty subsoil, thus establishing some measure of drainage. That hope was not realized, as was shown, for example, by the experiment quoted above. On the other hand, one may feel confident that *sufficiently heavy* applications of soil improvers, combined with suitable watering and provision for drainage, will profoundly change the character of the soil. We are at the moment engaged on a small-scale field experiment designed to indicate how far it is possible to establish drainage under these conditions. If eventually successful, it may be possible to say that some small area of the Gezira has been drained.

We are, however, forced at times—regrettably, but like everyone else—to interrupt our enjoyment of experimental data by brief but alarming reflections on questions of cost. You refer to a particular system of drainage as the only one which stands any chance of working successfully in the Gezira. That immediately simplifies the work of estimating costs. Let us say, first of all, that in view of all that has been done here in the past we are convinced that it would be useless to lay the first series of drains more than 50 to 60 cms. deep or more than 20 metres apart, and that an application of 10 tons per feddan of gypsum would be needed to make these drains work at all. Our cost per acre will then be, say, £E.0·40, and the capital cost of treating the whole Gezira in this way comes out at about thirty million pounds, before we begin to extend operations to the underlying layers of the soil.

This figure for cost should be noted in connection with the remarks which we have made earlier on the feasibility or desirability of big-scale capital expenditure in the Gezira.

And then what ? Your article clearly indicates that you are under the impression that proof has been obtained that, *if* we can get this soil aerated by drainage, we shall cease to be troubled any more by those fluctuations in yield which make our yield charts look like a mountain chain. But is this the case ? We spend much of our time here pondering over these mountain peaks and chasms, and, naturally, we have wondered what would happen if we grew cotton in a really good, fully permeable soil, with bottom drainage, right in the centre of the Gezira. The thing to do was to try it, and with two trainloads of some of the best soil of the Gash delta and a lot of digging we were able to dispense altogether with Gezira soil in three small plots at the Gezira Research Farm. These plots, started four years ago, have given each year a higher yield than the " control " plots of Gezira soil alongside—they are bound to do that, if only because the roots are able to penetrate, and do penetrate, to nearly three times the depth of those of plants grown on Gezira soil. But the important fact which has emerged to date from this experiment is that the yield still shows fluctuations from year to year of well over 100 per cent.—and the ups and downs follow the ups and downs of the yield from the whole Gezira.

You say in your article, " Experiments, as such, are not needed, except in the form of practical engineering," but in the face of a result such as we have described you will agree that experimental proofs *must* be obtained before proceeding on a large scale with a system which may fail altogether to give the required result.

It has been possible to present here only a small part of the information which has been collected. We hope, however, that we have made it clear that the defective permeability of Gezira soil and the desirability of soil improvement have long been recognized. Our numerous field experiments have not been more than partly successful and demonstrate that the process of transformation is difficult and costly. When attempting to anticipate the success of these experiments by importing a readily permeable soil we find that the seasonal fluctuations in cotton yield are regularly reproduced on this imported soil and infer from this that drainage, though desirable if workable and economically possible, would do nothing to relieve our most serious and pressing troubles.

III.—The Present Aspect of Soil Problems in the Gezira

The possibility that Gezira soil *may* deteriorate under irrigation remains our most important problem. It is necessary to realize, however, that we have as yet no reason to suppose that such deterioration must eventually take place; it is, in the present state of our knowledge, equally possible that Gezira soil is being slightly improved by irrigation.

In order to obtain further information on this point we are studying the course of base exchange under field conditions—that is, the reaction between a base saturated colloid, locally impregnated with salts, and the dilute solution of salts applied in irrigation. At present we have no indication of any "chemical and physical actions" which have been "intensified since the land was put under irrigation." Salts are brought on to the land by the river water. They do not remain at the soil surface, however, and no sign of upward movement of soil salts has been observed. There is, on the other hand, a slight indication of downward movement. It may be therefore that, since Blue Nile water is of good quality in respect to its calcium sodium ratio, normal irrigation has a slightly beneficial effect, such as would be intensified if the natural structure of the soil permitted greater penetration and leaching.

While we await conclusive results in respect to this difficult problem, we can at least feel that, whether or not soil deterioration may eventually occur, it will not be quick. It is impossible not to be impressed with the fact that excellent yields are not infrequently being obtained from this soil, which is, from the physical and chemical viewpoints, practically in its original state. Our *immediate* task is, therefore, to determine what are the conditions under which high yields are obtained, and *vice versa,* and to make use of this knowledge when obtained.

One possibility at present under consideration is that high yields normally occur when root damage by fungi is small. This suggests breeding of resistant varieties of cotton as a means of reducing the incidence of seasons in which the crop yield falls below an economic level. The results actually obtained to date in this direction are remarkably encouraging.

In respect to soil, attention is directed to changes in alkalinity, in nitrogenous components and in physical condition, and their relation to climatic conditions. It might, for example, be found that heavy rains are associated with higher alkalinity, increased damage by fungi and reduced yields. The practical management of Gezira soil for growing Egyptian cotton offers scope for soil investigations other than those associated with the possibly adverse effects of irrigation.

In addition to (1) soil deterioration and improvement and (2) the study of the factors responsible for seasonal variation in yield, a third subject for investigation which has been receiving considerable attention here relates to the changes in the carbon and nitrogen content of the soil, resulting from different systems of rotation and manuring. We have no reason to suppose that the rotation at present adopted in the Gezira is the best possible, and it may well be felt that an increase in animal stock and in the use of artificial fertilizers containing nitrogen would be advantageous. There is evidently much need for more adequate data as to the changes produced in soil by adoption of different systems of agricultural practice. Work of this character must find a place

in our soil investigations, and until the data have been obtained it is unwise to assume that it is impossible to devise some sequence of operations which would build up and maintain the fertility of the area.

IV.—Conclusion

Although we shall continue investigations directed to studying and controlling physical and chemical changes in the soil resulting from irrigation, and although we expect as part of this work to carry out drainage experiments somewhat as you suggest, we have at present no reason to believe that soil deterioration is either rapid or inevitable. This being the case, we must, in the meanwhile, pay attention to all aspects of the problem presented by the seasonal variation in yield, and must study the efficacy in the Gezira of systems of soil management which can be carried out at reasonable cost. Neither of these lines of investigation is, in its practical aspect, solely or even mainly a soil problem, but the soil investigations therein involved seem at present no less important than those which form the subject of your recommendations.

At any rate the Gezira Scheme is not dead yet nor even moribund: it has its bad days, but can be remarkably robust in between whiles.

We have a crop of cotton here this year which would surprise many who have been trying to grow Sakel in the Egyptian delta during recent years. And in our gardens the turnip and the spinach-beet blossom like the rose. Why not come up and see us some time?

Sincerely yours,
H. Greene.
M. A. Bailey.

Wad Medani,
Sudan.
March 10, 1935.

THE CORRELATION OF CERTAIN CHARACTERS IN EGYPTIAN COTTON

BY

C. H. BROWN,

Cotton Research Board, Giza.

DURING the course of examination of large numbers of targets[1] of pairs of characters, a considerable amount of data has been accumulated establishing the presence or absence of correlation between different pairs of characters which may be of general interest to cotton breeders. The following are the more important points noticed: Fig. 1, ginning outturn and halo length—absence of correlation; Fig. 2, ginning outturn and seed weight—negative correlation; Figs. 3 and 4, seed weight and boll-content weight—positive correlation; Figs. 5-8, seed weight and hair weight per cm.—positive correlation; Fig. 9, boll-content weight and hair weight per cm.—absence of correlation (the diagrams showing the best examples of these cases). The seed weight and boll weight correlation would obviously be expected, but it is surprising in what a large number of targets this is obscured by segregation in one or both characters. An example is shown of a clear correlation (Fig. 3), presumably where the strain is pure for both characters, and another (Fig. 4) of a badly spread distribution, but with the general tendency to correlation showing in spite of the impurity. The negative correlation between seed size and ginning outturn is also natural, assuming a constant weight of lint.

The most important new fact in these targets is the close correlation between seed weight and hair weight per cm. found in the purest strain (Giza 19), with a clear indication that the same phenomenon, obscured by genetic segregation in both factors, occurs in other strains and probably in all. As far as the writer is aware, correlation has not before been demonstrated from plant to plant, though very clearly demonstrated by Dr. W. L. Balls[2] in daily pickings. It is of considerable economic importance, indicating that purification for seed size automatically gives the greatest possible purity for fineness. In fact, segregation in seed size, a factor to which there is not generally given much attention in cotton breeding, although the original demonstration of "pure lines" by Johannsen was made with seed in beans, has been found in most of the Egyptian strains examined. Fig. 2 clearly shows such seed-size segregation.

Fig. 8 shows genetic segregation for hair weight, each hair weight group forming a correlation line with the fluctuations in seed weight.

The hair weight per cm. measurements are not made on the whole of the plants of the purity chequer, but only on those proving more or less typical for other characters, as otherwise the labour involved would be prohibitive. It is assumed, however, that the measurement of a wider range of seed weights in any target would show the same correlation. This follows from the examination of Figs. 5-7. Here the same Ashmouni nucleus (Giza 19) has shown identical correlation diagrams for two different years, centring on different values due to environmental difference, and on putting the two targets together the values are seen to lie on the same line. The exact agreement is really remarkable, and again shows that any measure of the variability of seed weight would automatically measure the variability of fineness. This direct correlation is presumably the simple physiological one of the larger seed furnishing more food material to the hair cell, and thus laying down more secondary thickening in each growth ring. The targets have been prepared with the seed weight plotted against hair weight $\times \sqrt{\text{hair weight}}$ to make both three-dimensional. The somewhat curious point of the very large change in hair weight for a given change in seed weight may be noted without any explanation being offered. Plotting seed weight against hair weight directly, the slope of the correlation line is still steeper than 45°.

Having found that seed weight and boll-content weight are correlated, and also seed weight and hair weight, a correlation between boll weight and hair weight would be expected to follow. But in fact this target tends to the circular form of non-correlated factors, particularly in the purer strains, the plants forming Fig. 9 being the same as those forming Fig. 5. The writer does not pretend to explain why this should be, but would point out that the number of hairs per seed and also number of seeds per boll is now implicated. It will be noticed that the finest plant in Fig. 5 is now much more clearly differentiated from the group and shown to be an off-type.

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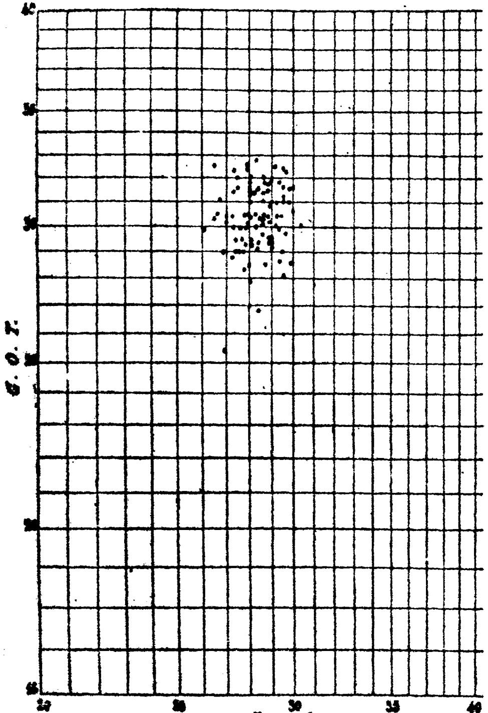
1. Brown, C. H. "The Purity Chequer in Cotton Breeding," *E.C.G.R.*, April, 1932.
2. Balls, Dr. W. L. "Growth Fluctuations during the Development of Seed Cotton," *Technical Bulletin* No. 101, Ministry of Agriculture, Egypt.

Received April, 1935.

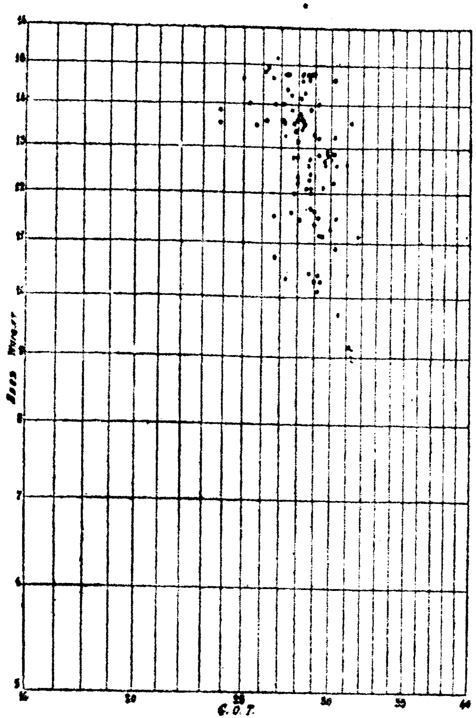
Fig. 1

1934 - GIZA 19



1931. GIZA 12

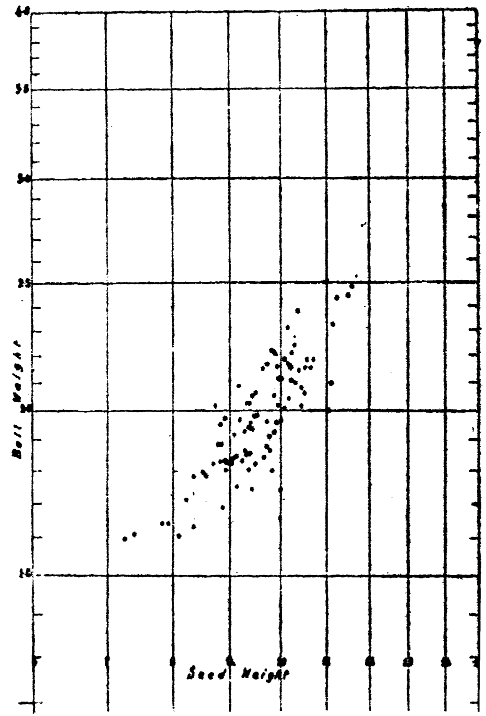
Fig.



BOLL Wt. v SEED Wt.

1934 - GIZA 25

Fig. 1



Boll Wt. & Seed Wt.

Fig. 8

1934. Commercial Manda

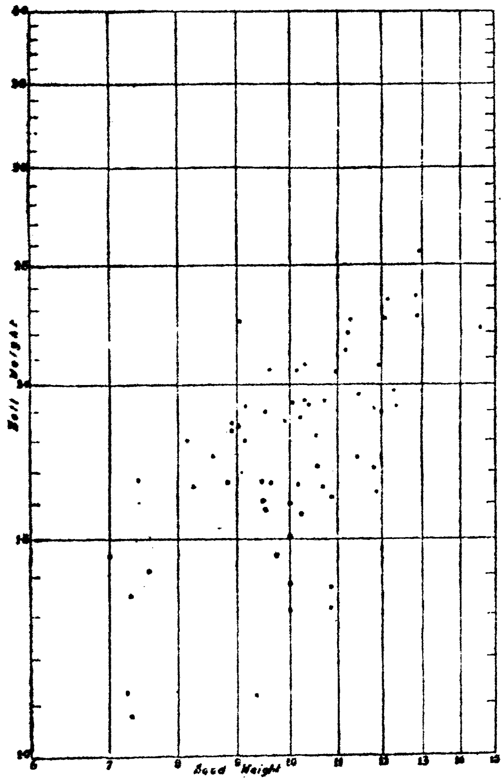


Fig. 5

1932 · GIZA 19

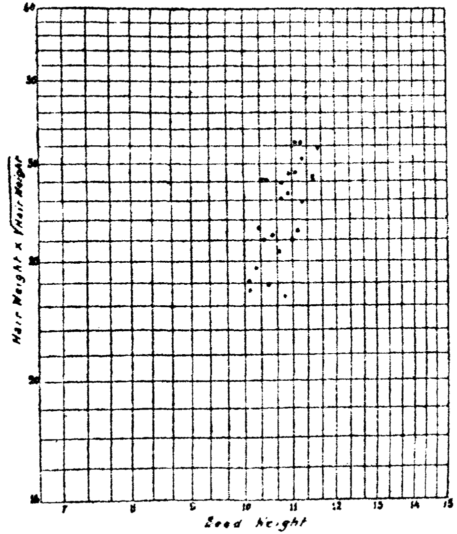


Fig. 6

1934 GIZA 13

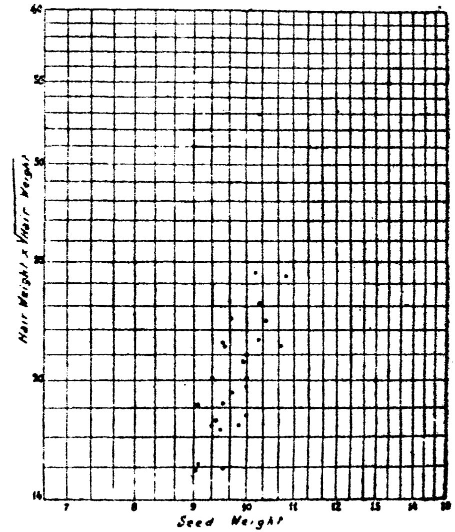


Fig. 7

1932 & 1934 - GIZA 19 : {1932 xxx, 1934 ...}

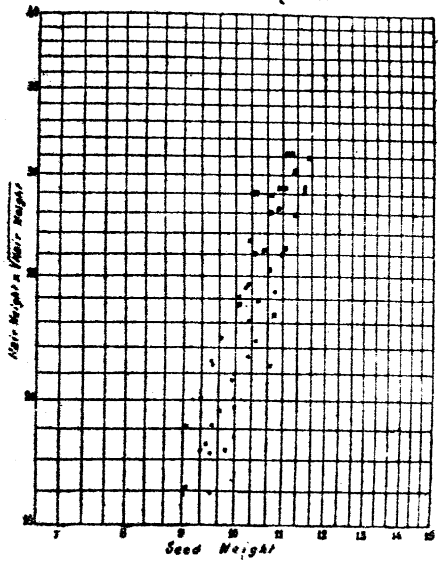


Fig. 8

1934 GIZA 24

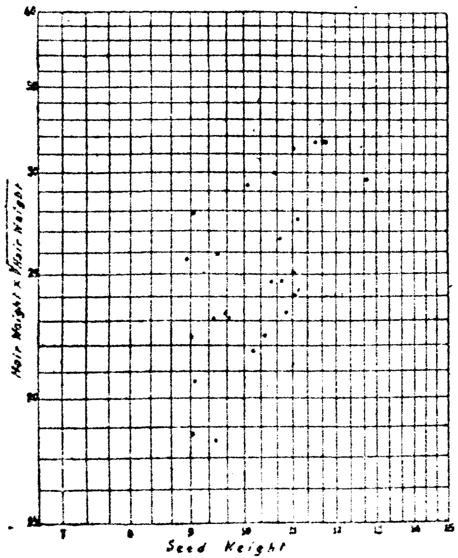
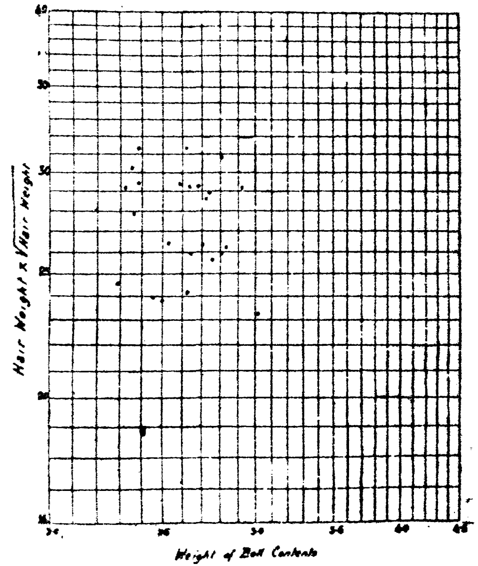


Fig. 9

1932 - GIZA 19



COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

World's Crops.—Since our World's Crops table last appeared in January, the estimates for 1934-35 have suffered a double revision. As pointed out in the April issue, the tendency at that time was towards the reduction of the estimates for some of the principal Outside Growths, especially Egyptian, Indian, and Russian. Since then, however, that tendency has been reversed in every case except Egyptian, while the estimates of other crops have also been increased, substantially in some cases. Thus the first official complete estimate of the Brazilian crop raised the figure to 1,591,186 bales, but as there have since been reports of considerable insect damage to the Sao Paulo crop, our figure of 1,412,000 bales, which is the mean of various estimates, will probably prove to be nearer the truth. It is still, of course, a new record by a very long way. The Indian crop has made a very good recovery to 4,807,000 bales in the supplementary estimate from 4,318,000 bales in February. The later revisions of the China crop are upwards, and the reports of a lower yield for Russia have given place to a further upward revision, which makes the 1934 crop in both cases a new record. Of the Empire crops, Sudan has also broken the 1931 record, but Uganda this year has been disappointing. Nigeria is promising a most satisfactory recovery, which will probably exceed the previous record of 1925.

The result of all these upward revisions is that the total of Outside Growths this year now looks like being about 14¾ million bales. It is worth noting that our detailed sheets, from which this table is made up, contain three new countries added in the last two or three years—namely, Manchuria (included with Japan and Korea), the Philippine Islands, which produced some cotton before the War, but had dropped out completely, and Rumania. The figures are not large in any of these cases, but they are significant.

American.—The American crop table gives the latest revised figures for 1934-35, and shows how these compare with the progress of the estimates throughout the season. The acreage figures which were raised in December have been reduced again to rather less than the original figures, with the result that the average yield has been

raised to a new high point for the season at 170·9 lbs. per acre. As the average of the ten previous years (including the bumper yields of 1931 and 1933) was only 177·1 lbs., this is very good for a drought year. In the last similar season (1930) the average yield was only 157·0 lbs. per acre.

Indian.—In the April issue we referred to the fact that the Indian Central Cotton Committee had recently revised the distribution of the crop between long and short staple, the Barsi and Nagar and Salem crops being transferred from long to short staple. In the detailed figures of the Indian crop by varieties we have therefore adopted this revision, and in order to show the effect of the inclusion of Barsi and Nagar among Oomras, we have given the details back to 1932-33, which may be compared with the last issue of this table in July, 1934. As then explained, however, we are unable to give effect to the further revision which the Committee make by allocating small parts of the Broach crop to short staple, and of the C.P. Oomras crop to long staple. These two, however, to some extent cancel out, the advantage being, if anything, in favour of long staple.

Egyptian.—The Government's final estimate in June of the Egyptian crop should be available in time to be included in this table, but it is obvious that it will be considerably less than the December estimate of 7,801,000 kantars formerly used.

The Egyptian Carryover took an unexpected turn at mid-season, when it appeared from the Federation statistics that the world's mill stocks were very much larger than in July or in January last year, with the result that the mid-season total was just about a million kantars less than in January, 1934. That, however, was quite in accordance with the developments of the crop and consumption statistics, with an indicated crop of about 7½ million kantars and consumption for the first half of the season running at the rate of about 8½ million kantars. The result is that the indicated Carryover at the end of the season is now about 4 million kantars, which marks a very healthy return to normal conditions.

Consumption.—The Federation statistics of Consumption and Stocks as at 31st January contained a great disappointment in the fact that the German figures (as well as the Russian) were not available, and unfortunately the Federation were not able to include even an estimate of the figures as they do in the case of Russia. In our view, however, the absence of the German figures would so invalidate comparisons with previous periods that we have thought it better to insert an estimate; we have used the average of the last ten half-

years which, as it happens, is a very moderate figure, and in any case any error would have only a slight effect on the comparative totals.

The general result of the consumption figures is really startling. The total consumption of Outside Growths is 6,959,000 bales against 5,892,000 American, and judging from the movement of the consumption figures since 31st January, as shown by the U.S. consumption figures (given in the next table) and Garside's estimates for the rest of the world, it appears that the figures for the whole season are likely to be about 14 million bales for Outside Growths against 11½ million American! It will be noted that the Federation figure of Outside Growths is much higher than Garside's estimate, which we used in the special article on American Cotton Legislation in the April issue, but Garside has since revised his figures for the first half of the season to 7,114,000 bales Outside Growths and 5,752,000 American.

Prices.—Just about the time when our April issue was going to press, the American markets suddenly staged an entirely unexpected collapse. It was largely psychological, being due to (1) the fact that prices went slightly below the "peg" and the Government took no action; (2) rumours that the Bankhead quota restriction for the 1935 crop was to be practically destroyed by exempting small growers; and (3) disappointment amounting almost to resentment in the market at the Government refusal to define their loan policy for the coming season, which incidentally was entirely unreasonable, as the Government never have fixed their loan policy until a later date in the season, when the position of supply can be at least estimated. The fact is, however, that the price in New York slumped nearly 2 cents before it was finally checked, but the greater part of this loss has since been recovered.

During May there was an important development in the decision of the authorities as holders of the Government "Pool" cotton to release a certain amount of spot cotton against purchases of futures, both old and new crop months. At the same time they announced that if necessary to protect the near months they would call for delivery against the July futures. The immediate effect was to narrow very substantially the discount on new crop months, which has been a characteristic feature of the market since last October.

The effect of the American slump on the relative prices of Egyptian and of other Outside Growths was interesting. It will be remembered that when American jumped to a new high level last August, Egyptian and other Outside Growths lagged behind; but when during the

autumn months American sagged a little, most of the Outside Growths improved their relative position and marked higher percentages. When American collapsed in March, however, they once more lagged behind on the decline, so that their position again improved relatively; but when American recovered, Outside Growths once more moved more slowly and marked a considerable reaction in the percentage figures.

The decision of the U.S. Supreme Court on 28th May against the constitutionality of the N.R.A. codes again upset the market very badly, owing to the fear that the A.A.A. would also be involved.

WORLD'S COTTON CROPS.

(Bales of 500 Lbs.—000's.)

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.
U.S.A. Lint	14,825	13,932	17,096	13,002	13,047	9,636
Linters	1,241	986	1,067	912	982	975
Total	16,066	14,918	18,163	13,914	14,029	10,611
Mexico	240	174	203	99	255	209
Brazil	564	460	554	500	939	1,412
Peru	266	249	228	231	293	280
Argentine	138	136	165	146	195	200
Other South American	66	57	46	39	64	70
India*	5,243	5,224	4,007	4,657	5,068	4,807
China	2,055	2,317	1,733	2,195	2,633	3,115
Japan and Korea ...	137	147	99	129	218	255
East Indies, etc. ...	18	18	15	14	14	14
Russia	1,279	1,589	1,846	1,757	1,846	1,937
Persia	73	64	107	79	100	100
Iraq, Ceylon, etc. ...	4	3	1	†	†	2
Asia Minor and Europe	143	120	131	68	189	174
Egypt	1,706	1,655	1,271	991	1,715	1,511
Sudan	127	96	188	110	126	212
East Africa (British)	131	166	182	269	263	236
South Africa (British)	14	8	3	2	3	3
West Africa (British)...	35	15	5	20	22	40
Non-British Africa ...	121	125	96	121	153	150
West Indies (British)...	4	4	2	2	3	3
West Indies (Others) ...	25	21	31	26	23	29
Australia, etc.	12	10	4	11	18	18
World's Total ...	28,467	27,576	29,080	25,380	28,169	25,388
Outside Growths ...	12,401	12,658	10,917	11,466	14,140	14,777
Per cent. on Total ...	43·6	45·9	37·5	45·2	50·2	58·2

* Government estimate, 400 lb. bales. † Less than 500 bales.

AMERICAN CROP (EXCLUDING LINTERS).

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.
Acreage planted (000's)	44,458	43,339	39,109	36,542	40,852*	27,883
Acreage harvested ...	43,242	42,454	38,705	35,939	29,978	26,987
Crop (running bales)...	14,548	13,756	16,629	12,710	12,664	9,472
Yield per acre (lbs.) ...	164·1	157·0	211·5	173·3	208·5	170·9
Season's average spot price (Liverpool—pence per lb.) ...	9·09	5·71	4·82	5·62	6·02	—

PROGRESS OF THE SEASON 1934–35.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	28,024	28,024	28,024	28,024	28,412	28,412
Acreage harvested ...	27,371	27,241	27,241	27,241	27,515	27,515
Crop (500 lb. bales) ...	9,195	9,252	9,443	9,634	9,731	9,634
Yield per acre (lbs.)...	160·9	162·6	165·9	169·3	169·2	167·4

* Less 10,396,000 acres special abandonment.

INDIAN—AREA AND CROP *BY VARIETIES.*

Varieties.	1932-33.			1933-34.			1934-35.		
	Area.	*Crop.*	*Yield per Acre.*	*Area.*	*Crop.*	*Yield per Acre.*	*Area.*	*Crop.*	*Yield per Acre.*
Mainly under ⅞" Staple:									
Oomras, Khandesh	1,062	215	81	1,116	274	98	1,109	253	91
Central India ...	1,604	209	52	1,766	213	48	1,806	189	42
Barsi and Nagar	2,450	364	59	2,346	376	64	2,078	302	58
Berar	2,828	500	71	2,948	506	69	2,913	468	64
Central Prov. ...	1,172	320	109	1,322	212	67	1,327	143	43
Total ...	9,116	1,608	71	9,498	1,581	67	9,233	1,355	59
Dholleras	2,747	712	104	2,386	570	96	2,925	588	80
Bengal Sind* ...	2,807	774	110	3,999	1,234	123	3,861	1,331	138
Comillas, Burmas, etc.	478	105	88	578	142	98	574	132	92
Coconadas ...	189	26	55	170	24	56	179	29	65
Salems	191	35	73	200	37	74	186	32	69
Total under ⅞" ...	15,528	3,260	84	16,831	3,588	85	16,958	3,467	82
Per Cent. of Grand Total	69·1	70·0		69·7	70·8	—	71·2	72·1	—
Mainly ⅞" and above:									
American, Punjab	776	217	112	809	364	180	836	397	190
,, Sind ...	99	33	133	184	61	133	194	76	157
Broach	1,308	322	98	1,283	228	71	1,378	152	44
Coompta-Dharwars	1,451	230	63	1,362	185	54	1,090	125	46
Westerns & Northerns	1,568	189	48	1,770	206	47	1,435	140	39
Tinnivellies ...	541	135	100	575	130	90	575	123	86
Cambodias ...	322	139	173	346	153	177	500	198	158
Hyderabad-Gaorani	890	131	59	976	153	63	864	129	60
Total ⅞" and above...	6,955	1,396	80	7,305	1,480	81	6,872	1,340	78
Per Cent. of Grand Total	30·9	30·0	—	30·3	29·2	—	28·8	27·9	—
Grand Total ...	22,483	4,656	83	24,136	5,068	84	23,830	4,807	81

* United Provinces, Rajputana, Sind, Punjab, etc.

EGYPTIAN CROP.

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.
Area (feddans, 000's) ...	1,841	2,082	1,683	1,094	1,804	1,732
Crop (kantars, 000's):						
Alexandria adjusted arrivals	8,485	7,947	6,563	5,050	8,438	7,540
Government figures *	8,531	8,276	6,357	4,956	8,575	7,555
Average yield (kantars per feddan)*	4·63	3·97	3·78	4·53	4·75	4·36
Season's Average Spot Prices (Liverpool—Pence per Lb.).						
Sakel	14·52	9·06	6·80	7·79	8·05	
Percentage on American	59·7	33·6	41·1	38·6	33·7	
Uppers	10·47	6·86	5·68	7·01	6·64	
Percentage on American	15·2	20·1	17·8	21·7	10·3	

* Final revised figures, including Searto.

WORLD'S CARRYOVER OF *EGYPTIAN* COTTON.

(KANTARS 000's.)

End of	*Stock and Afloat.* *U.K.*	*Stock and Afloat.* *Continent.*	*U.S.A.* *Mills.*	*U.S.A.* *Warehouses.*	*Alexandria.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.**
1929, July ...	510	150	449	197	1,677	2,983	1,260	4,243
1930, January	*585*	*270*	*353*	*202*	*3,403*	*4,813*	*1,335*	*6,148*
July ...	353	135	483	245	3,616	4,834	1,297	6,131
1931, January	*630*	*293*	*341*	*129*	*5,349*	*6,742*	*1,185*	*7,927*
July ...	600	165	212	108	4,456	5,541	1,418	6,959
1932, January	*1,013*	*248*	*145*	*63*	*5,521*	*6,990*	*1,447*	*8,437*
July ...	885	203	161	180	3,780	5,209	1,553	6,762
1933, January	*878*	*218*	*134*	*169*	*4,255*	*5,654*	*1,425*	*7,079*
July ...	742	202	131	143	2,228	3,446	1,635	5,081
1934, January	*1,507*	*337*	*143*	*106*	*3,157*	*5,250*	*1,687*	*6,937*
July ...	1,132	248	174	135	1,491	3,180	1,868	5,048
August	1,050	195	178	128	974	2,525	—	—
September	998	203	173	131	1,229	2,734	—	—
October	990	232	160	112	1,966	3,460	—	—
November	1,027	330	149	108	2,048	3,662	—	—
December	975	315	148	110	2,470	4,018	—	—
1935, January	968	435	134	100	2,230	3,867	*2,108*	*5,975*
February	952	465	130	112	2,171	3,830	—	—
March	870	420	129	116	2,081	3,616	—	—
April ...	848	353	124	121	1,866	3,312	—	—
May ...	705	323	—	—	—	—	—	—

Figures in *italics* to distinguish between mid-season and end of season.

WORLD'S CONSUMPTION OF COTTON.

(From the Statistics of the International Federation.)

(Running Bales, 000's—Excluding Linters.)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals.*
American.	1929–30	1,474	4,055	5,803	1,427	256	13,015
	1930–31	991	3,242	5,084	1,345	239	10,901
	1931–32	1,342	3,343	4,744	2,636	251	12,316
	1932–33	1,400	3,836	6,004	2,655	276	14,171
	1933–34	1,461	3,976	5,553	2,238	306	13,534
	1934–35*	*533*	*1,591*	*2,613*	*1,002*	*153*	*5,892*
Indian.	1929–30	188	1,375	61	4,403	60	6,087
	1930–31	252	1,215	43	4,318	35	5,863
	1931–32	183	727	21	3,834	23	4,788
	1932–33	126	600	16	3,455	23	4,220
	1933–34	234	844	14	3,638	42	4,772
	1934–35*	*170*	*440*	*8*	*2,353*	*7*	*2,978*
Egyptian.	1929–30	301	415	137	58	26	937
	1930–31	242	420	70	96	25	853
	1931–32	301	480	53	120	26	980
	1932–33	301	442	58	104	29	934
	1933–34	366	515	69	119	39	1,108
	1934–35*	*181*	*257*	*31*	*81*	*21*	*571*
Sundries.	1929–30	502	2,044	51	1,825	740	5,162
	1930–31	479	1,984	42	1,648	711	4,864
	1931–32	560	1,730	26	1,133	786	4,235
	1932–33	421	1,797	32	1,922	856	5,028
	1933–34	409	2,137	33	2,154	964	5,697
	1934–35*	*367*	*1,220*	*9*	*1,235*	*576*	*3,410*
All kinds.	1929–30	2,465	7,889	6,052	7,713	1,082	25,201
	1930–31	1,964	6,861	5,239	7,407	1,010	22,481
	1931–32	2,386	6,280	4,844	7,723	1,086	22,319
	1932–33	2,248	6,675	6,110	8,136	1,184	24,353
	1933–34	2,470	7,472	5,669	8,149	1,351	25,111
	1934–35*	*1,251*	*3,508*	*2,661*	*4,671*	*760*	*12,851*

* First half-season.

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1933–34.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
November ...	475·4	22·1	461·8	0·9	9·0	3·6	59·1
December ...	348·4	19·4	338·9	1·1	6·2	2·2	51·6
January ...	508·0	22·3	493·8	1·1	10·2	2·9	57·8
February ...	477·9	24·2	463·8	1·5	9·3	3·3	59·7
March ...	543·7	24·7	527·9	1·3	10·7	3·8	74·5
April ...	512·7	24·4	499·1	1·1	8·6	4·0	67·8
May ...	519·8	22·8	507·1	1·0	7·4	4·3	63·9
June ...	363·4	17·3	352·9	1·0	6·3	3·2	55·0
July ...	359·4	17·1	349·7	0·6	6·1	3·0	63·0
1934–35.							
August ...	420·9	18·3	409·4	0·8	7·8	2·9	61·2
September ...	296·0	15·0	289·3	0·3	4·5	1·9	54·7
October ...	520·3	22·9	506·6	0·9	10·4	2·5	57·4
November ...	477·1	22·2	465·1	0·8	8·5	2·7	51·4
December ...	413·5	21·8	403·5	0·8	6·8	2·5	52·1
January ...	546·8	24·0	534·3	0·9	8·7	2·9	61·8
February ...	478·3	24·2	467·1	0·7	7·3	3·1	62·8
March ...	481·1	22·9	469·6	0·8	6·9	3·8	66·8
April ...	462·8	21·3	450·8	1·1	6·8	4·1	70·3

HIGHEST AND LOWEST FUTURES PRICES.

1933–34.	*American.*				*Egyptian (Liverpool).*			
	New York.		*Liverpool.*		*Sakel.*		*Uppers.*	
	High.	*Low.*	*High.*	*Low.*	*High.*	*Low.*	*High.*	*Low.*
February	12·54	11·53	6·48	5·92	*9·25*	8·36	7·23	6·61
March ...	12·38	11·71	6·40	6·04	8·91	8·35	6·99	6·69
April ...	12·23	10·86	6·14	5·62	8·62	7·90	6·80	6·18
May ...	11·59	10·70	6·05	5·57	8·37	7·88	6·63	6·14
June ...	12·52	11·61	6·55	5·94	8·48	8·22	6·98	6·55
July ...	*13·35*	12·03	*6·97*	6·28	8·60	8·10	*7·31*	6·75
1934–35								
August ...	*13·84*	12·97	*7·23*	6·77	8·71	8·29	7·54	7·19
September	13·43	12·35	7·00	6·57	8·65	7·87	7·59	7·02
October ...	12·53	11·96	6·70	6·43	8·21	*7·65*	7·19	6·74
November	12·66	12·02	6·80	6·45	*8·85*	7·99	7·58	6·97
December	12·72	12·44	6·89	6·64	8·79	8·46	7·64	7·38
January ...	12·75	12·27	6·94	6·75	8·72	8·51	*7·75*	7·56
February	12·73	12·26	6·88	6·68	8·58	8·36	7·58	7·38
March ...	12·49	*10·25*	6·97	*5·95*	8·61	7·69	7·65	*6·70*
April ...	11·90	10·83	6·54	5·97	8·16	7·86	7·34	6·87
May ...	12.19	10·95	6·56	6·29	8·16	7·86	7·47	7·16

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1933–34.	*American (Midlling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Midlling).*	*Brazil Pernam (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
February	6·67	73·2	98·5	97·8	107·5	118·0	107·9	136·6
March ...	6·35	70·1	98·4	94·5	107·9	118·9	108·0	137·6
April ...	5·88	70·9	100·0	94·9	109·4	121·3	106·5	137·2
May ...	6·20	75·2	99·2	95·2	108·9	120·2	107·6	135·8
June ...	6·84	73·2	99·3	95·6	107·3	118·3	102·8	122·1
July ...	6·97	72·5	98·6	96·4	106·5	117·2	104·0	122·0
Season's average	6·02	75·1	99·5	98·8	110·8	121·4	110·3	133·7
1934–35.								
August ...	7·11	70·5	99·3	96·5	105·6	116·2	105·1	122·9
September	6·91	69·8	99·3	96·4	106·5	116·6	103·9	121·7
October ...	6·92	68·1	98·6	95·7	107·2	114·5	105·2	118·8
November	6·96	70·7	98·1	95·3	106·8	114·7	108·8	129·3
December	7·20	73·8	98·2	95·4	107·9	113·5	109·4	124·2
January ...	7·08	77·5	98·6	95·8	109·9	113·4	112·6	127·1
February	7·10	77·5	99·3	96·5	110·6	113·4	107·3	124·8
March ...	6·36	80·3	99·5	96·4	112·1	114·5	116·8	130·3
April ...	6·78	82·2	99·3	96·3	111·1	113·3	117·1	124·6
May ...	6·92	77·7	97·1	94·9	107·2	109·4	109·8	117·9

EMPIRE COTTON CROPS FOR THE YEARS 1924–34, EXCLUDING INDIA.

(*In bales of 400 lbs.*)

The seasons are given as covering two years (*e.g.*, 1926–1927) because in the majority of the countries named planting takes place in one calendar year and picking in the next. In a few of these countries, however (*e.g.*, Tanganyika, Cyprus, Malta and some of the West Indian Islands), the crop is harvested in the same year as that in which it is planted. In such cases the figures should be read as relating to the crop grown and harvested in the *latter* of the two years at the head of the column.

Country.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	
(1) Anglo-Egyptian Sudan ..	47,652	44,912	121,131	148,118	126,115	161,536	157,769	120,310	234,964	137,384	157,625	(1)
(2) Uganda ..	128,604	196,038	180,859	131,728	138,486	204,057	129,969	191,305	203,265	294,828	285,986	(2)
(3) Kenya ..	1,653	2,250	2,046	1,232	1,241	1,984	1,518	737	1,735	4,277	6,750	(3)
(4) Tanganyika ..	18,793	21,724	24,280	15,966	32,954	27,785	23,135	11,351	18,039	30,834	38,087	(4)
(5) Nyasaland ..	6,873	7,718	4,976	2,792	4,470	6,095	9,331	4,205	5,067	5,912	10,713*	(5)
(6) N. Rhodesia ..	500	379	506	32	17	—	—	—	—	—	—	(6)
(7) S. Rhodesia ..	1,650	4,907	6,803	639	90	280	1,481	1,974	579	355	689	(7)
(8) Union of South Africa and Swaziland	8,730	16,936	20,381	10,242	11,013	9,774	16,213	8,123	2,801	1,860	2,440	(8)
(9) Nigeria ..	25,694	39,137	47,909	27,464	20,930	32,126	43,925	18,850	6,268	24,366	28,212	(9)
(10) Gold Coast ..	93	1,132	1,218	285	264	296	200	297	263	68	144	(10)
(11) Cyprus ..	3,397	3,320	4,614	2,110	2,146	3,520	4,718	2,865	1,119	913	1,865	(11)
(12) Malta ..	573	782	507	342	541	379	293	201	41	34	32	(12)
(13) Iraq	2,400	2,540	3,500	1,800	5,200	4,700	3,300	960	409	—	—	(13)
(14) Ceylon ..	324	121	261	186	202	380	248	95	47	34	92	(14)
(15) Queensland ..	11,850	14,318	7,179	5,880	10,266	6,296	13,999	12,228	4,975	13,903	21,924	(15)
(16) Fiji	157	123	824	356	114	271	398	266	90	8	39	(16)
(17) West Indies ..	4,309	4,186	5,941	6,076	4,088	5,312	5,672	5,106	2,524	2,614	3,618	(17)
	263,252	360,523	432,935	355,248	358,137	464,791	412,169	378,873	482,186	517,420	558,216	
	Percentage Increase 50·6	*Percentage Increase* 36·9	*Percentage Increase* 20·0	*Percentage Decrease* 17·9	*Percentage Increase* 0·8	*Percentage Increase* 29·7	*Percentage Decrease* 11·3	*Percentage Decrease* 8·0	*Percentage Increase* 27·2	*Percentage Increase* 7·3	*Percentage Increase* 7·8	

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

336. The following reports have recently been received:

AGRA AND OUDH: Rpt. on Admin. of Dpt. of Agr., 1934.
INDIAN CENTRAL COTTON COMMITTEE: Ann. Rpt. to August 31, 1934.

337. INDIAN COTTON: REVIEW OF THE 1933-34 SEASON. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of the *Indian Cotton Review for the* 1933-34 *Season.* The total mill consumption of Indian raw cotton in India, including States, amounted to 2,336,000 bales, compared with 2,361,000 bales in the previous year. The decline was partly due to the continuance of a textile strike in Bombay, and partly to the production of finer yarns and piece-goods which, comparatively speaking, require less of the raw material. Total exports of Indian cotton to foreign countries during the season approximated 3,267,000 bales, which compare favourably with 2,757,000 bales in 1932-33 and 1,472,000 bales in 1931-32.

In regard to the prospects for the 1934-35 season, it is reported that the outturn of Oomra, Broach and other strains shows a cumulative decline of 251,000 bales from last year. This decline has been partially offset by the estimated increase of 187,000 bales in the outturn of Bengals, Dholleras and American varieties. In these circumstances an estimate of 5,625,000 bales is given for the 1934-35 crop.

The report contains several tables of statistics dealing with the World supply, distribution and stocks of Indian cotton, Bombay cotton prices, Bombay weekly cotton movements and stocks, Indian cotton acreage and crop, Consumption of Indian cotton in India, Exports, etc.

338. LONG STAPLE COTTONS: CULTIVATION IN INDIA. By R. D. Mihra. (*Ind. Text. J.*, **45**, 1934, p. 155. Abstr. from *Summ. of Curr. Lit.*, xv., **8**, 1935, p. 194.) A short account is given of the efforts being made to promote the cultivation of long staple cottons in India. Seed distribution schemes are in operation in various regions and tests are being made with American, Punjab-American, Sea Island and Egyptian types of cotton.

339. LIST OF COTTON PRESSING FACTORIES, WITH NAMES OF OWNERS AND PARTICULARS OF MARKS ALLOTTED TO THEM IN THE DIFFERENT PROVINCES OF BRITISH INDIA AND CERTAIN INDIAN STATES, FOR THE SEASON 1934-35. (No. 2723. Obtainable Manager of Publications, Delhi. Price: As. 12 or 1s. 3d.)

340. INDIAN CENTRAL COTTON COMMITTEE. (*Ann. Rpt. to August* 31, 1934.) The work of the year was of considerable importance; special attention was devoted to the increased production of cotton suitable for finer counts. 1027 A.L.F. was finally proved more suitable than 1.A. for south of the Nerbudda. Keen interest was taken in the efforts made by the Lancashire Indian Cotton Committee to increase the consumption of Indian cotton in Lancashire. These efforts resulted in the United Kingdom taking 355,534 bales during the year, as compared with 242,601 bales in the previous season, and 122,082 bales in 1931-32. The Cotton Transport Act and the Cotton Ginning and Pressing Factories Act continued to function successfully in most districts. Further progress was made in the prevention of malpractices, in the establishment of cotton markets, the preparation of Universal Standards for Indian cottons in India, and in the publication of cotton statistics. The restrictions imposed by Government to prevent the introduction of foreign cotton pests remained in force throughout the year.

In connection with research, funds were provided for thirty-three research and other schemes, ten research students were under training, and two training grants for foreign study were awarded.

Continued progress was made in the work of the Technological Laboratory; 548 samples were spun, which establishes a new record and represents an increase of nearly 20 per cent. over last year's figure. At the Institute of Plant Industry, Indore, progress has been made in the selection of cottons for the Malwa plateau, the Gang Canal Colony of Bikaner State, and in the Nerbudda Valley, Nimar.

341. INDIAN CENTRAL COTTON COMMITTEE. At the thirtieth meeting, held on 4th and 5th February, the following important matters were discussed: A reference from the International Federation of Master Cotton Spinners' and Manufacturers' Associations suggesting a reversion to the original system of marking bales on hoops; a complaint from the Lancashire Indian Cotton Committee regarding the mixing of different types of cotton; the handicaps to which Indian cotton is subjected in foreign countries by way of tariff and other restrictions; the establishment of cotton markets in the Bombay Presidency and the Punjab; the broadcasting of commercial news relating to cotton. The various research schemes of the Committee were reviewed, five schemes were extended for a further period, and one new scheme sanctioned. The progress report of the Director of the Technological Laboratory at Matunga was adopted, and appreciation was expressed of the work carried out at the Laboratory.

342. TECHNOLOGICAL REPORTS ON STANDARD INDIAN COTTONS. By N. Ahmad. (*Tech. Circs.*, Nos. 154-157. 1934-35.) Copies have been received from the Indian Central Cotton Committee of reports on the cottons named below. The particulars include agricultural details, grader's report, fibre particulars, spinning tests, remarks and conclusions.

1. *Verum* 262 (*Nagpur*).—Area under cultivation 96,000 acres. The performance of this cotton has remained fairly constant. The 1934-35 sample was suitable for 28's warp.
2. *Verum* 262 (*Akola*).—Area under cultivation 96,000 acres. The 1934-35 sample is suitable for 22's warp.
3. *Umri Bani*.—Area under cultivation 813,480 acres. The 1934-35 sample was suitable for 30's warp.
4. *Punjab-American* 289 *F*.—Yarns spun from this cotton are usually neppy. The 1934-35 sample was suitable for 45's warp.

343. SPINNING TEST REPORTS ON INDIAN COTTONS. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.*, Nos. 158-165. 1935.) The circulars contain the report of the Standards Committee and spinning test results for C.P. No. 1, Berar, and Khandesh cottons, and the grader's report and spinning test results for Khandesh, Moglai, Bengals, Ujjain (Ujjain) and Ujjain (Mandusar) cottons for the 1934-35 season.

344. NOTES ON THE EXHIBITION IN THE ROYAL EXCHANGE BUILDINGS, MANCHESTER, OF TEXTILES MADE FROM INDIAN COTTON. By Dr. A. J. Turner. (Shirley Institute, Manchester.) The exhibition provided a remarkable revelation of the great variety of finished textiles that can be successfully made from Indian cotton without technical difficulty. A particularly interesting series of exhibits showed Indian cotton in various stages, from the raw cotton to the finished goods. The raw cottons were of the types which India can export in large quantities, Oomras and Bengals; staple diagrams of these, prepared by means of comb sorters and exhibited with the cottons, showed the characteristic features of these types. The yarns made from them were on view in the form of cop, ring tube, hank, cheese, and cone, and excellent hosiery was exhibited made from coarse

Indian cottons. Other series of exhibits showed coarse yarns in the grey, bleached and dyed forms, and made into white and coloured quilts; grey and bleached cloth manufactured from medium coarse ring warp and mule weft, and the same cloth attractively printed; medium coarse Indian weft combined with a medium fine American warp to make excellent brocade, shown in the grey state and also dyed both gold and black. Really outstanding among the exhibits were a number of heavy furnishing fabrics, and mention may also be made of other goods that can be manufactured from medium or less coarse counts, such as calicos, casement cloths, cretonnes, drills, prints, moleskins, raising cloths, sateens, shirtings, and surgical cloths. A striking feature of many of the exhibits was the excellent penetration of the dyestuff, and the examples of mixed fabrics—with American warp and Indian weft—dyed in different colours were ample evidence of technical success in dealing with the dyeing of such mixtures. It is hoped that the demonstration of the wide possibilities of Indian cotton will lead to a still greater demand for it, and a still greater increase in the imports of it into this country.

345. Indian Cotton: Statistics. We have received from the Secretary, Indian Central Cotton Committee, copies of Leaflets Nos. 2, 3 and 4, giving information regarding the following: Stocks of Indian Raw Cotton held in India by the Mills and the Trade on August 31, 1934; Receipts at Mills in India of Raw Cotton classified by Varieties, 1933-34 season; Exports by sea of Indian Raw Cotton classified by Varieties, 1933-34 season.

346. Agra and Oudh: *Cotton Cultivation*, 1933-34. (*Rpt. on Admin. of Dpt. of Agr.*, 1934, recently received.) The cotton growers of most of the province had a bad year from heavy and unseasonable rains, pest attack, and low prices. There was a marked recovery in area, by about 2¾ lakhs of acres, from the low level of 1932-33, to a total of nearly 8 lakhs of acres. C.520 extended its popularity, especially in the Bundelkhand, Rohilkhand, and Western Circles. C.402, which is the best staple departmental cotton, was grown in various parts of the Sarda Circle, notably in the Madhoganj tract, where the area nearly doubled, to 3,461 acres. The marketing of this cotton was again largely managed by the Belgaum Co-operative Cotton Society, and sold through a Cawnpore firm. The profits on the transaction amounted to over Rs. 5,000, which enabled the distribution of a bonus of 8 annas per maund of kapas to the cultivators, and the building up of a substantial reserve for further operations.

The enquiry into the cost of cultivation of cane and cotton, financed by the Imperial Council of Agricultural Research and the Indian Central Cotton Committee, continued on the same lines as last year.

Work in connection with the control of pink bollworm was continued throughout the season.

347. Bengal: *Hand Weaving.* (*Text. Weekly*, xv., **368**, 1935, p. 318.) The Government of Bengal have decided to put into force their scheme for the revival of the hand-loom industry of the province, as they are now supplied with sufficient funds from the Central Government. The scheme takes into account the difficulties experienced by the hand weavers in the past, and intends to start with the strengthening of the co-operative industrial unions, which will be reconstituted and assisted by the staff of weaving and dyeing experts to train weavers in up-to-date methods and processes. There will also be a marketing officer and research staff, the duty of the latter being to study the changing fashions of the market, to watch the opportunities for new ranges of textures and ornamental styles likely to attract the public.

348. Karachi Cotton Annual, 1933-34. (Pubd. by the Karachi Cotton Assen. Ltd., Karachi, Sind. Price Rs. 2.) We have received a copy of the first issue of

this useful compendium of all matters relating to the Karachi Cotton Trade, with particular reference to Sind, the Punjab, United Provinces, and Rajputana. The first section gives a list of all the members of the Karachi Cotton Association, the reports of the Directors, and an interesting paper on "Cotton Cultivation in Sind," by the Chief Agricultural Officer in Sind, Mr. W. J. Jenkins. The second section contains numerous statistical tables of crops, exports, prices, stocks, etc., and the final section deals with legislation relating to ginning, pressing, etc.

349. MADRAS: *Combined Report on the Investigations into the Finance, Sowings, and Marketing of Cultivators' Cotton in the Tirupur Tract, Season* 1932-33. By S. V. Duraiswami. (*Agr. and Livestock in India*, v., **1**, 1935, p. 18.) Describes investigations carried out in the two most representative villages of the Tirupur tract, where the important types of cotton, Cambodia and Karunganni, are grown.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

350. BRITISH COTTON GROWING ASSOCIATION. The 30th Annual Report of the Association dealing with the twelve months ending 31st December, 1934, contains much valuable information on its work in India and in other parts of the Empire. Full details are given of the work of the B.C.G.A. (Punjab), Ltd., and other sections record progress in the West Indies and in various parts of Africa. The section dealing with Nigeria records that the quantity of seed distributed for the 1935 crop has reached the high figure of nearly 4,000 tons, and it is regarded as probable that a record crop will be harvested. In Nyasaland the extension of the railway, coupled with an improvement in cotton prices, has stimulated a return to production in various districts in which cultivation has been in abeyance for some years, and it is hoped that they will continue in production now that transport facilities have improved. Cotton production in Empire fields generally shows satisfactory progress, but it is regretted that no improvement can be reported in the state of the cotton industry in this country during the past year.

351. ASIA CYPRUS: *The Agricultural Resources of Cyprus*. By A. Pitcairn. (*Cyprus Agr. Journ.*, xxx., **1**, pp. 6-13.) The article contains a description of the principal geographical and climatic features of Cyprus, and illustrates their effect on the crops grown. The average annual rainfall being roughly only 20 inches, irrigation is essential for the agricultural development of the island, and without it production would be extremely limited, and the agricultural requirements necessary to support the existing population and livestock could not be met. The different systems are described by which water is made available for irrigation purposes. A short description is given of the laws in force for land tenure and their effect on the systems of agriculture. As regards markets, Cyprus has, in the past, been able to market its surplus products in the neighbouring countries of Egypt, Greece, Palestine, and Syria. World economic conditions have caused considerable changes in the last few years, and marketing in the countries named is no longer easy on account of restrictions on imports, or of competition from other producing countries. Search is accordingly being made for new markets, and in order to enable the products of Cyprus to compete with those of other countries, stress is laid on the necessity for the grading and inspection of produce for export. An inspection service has been organized by the Department of Agriculture. It is pointed out that many areas are planting crops under conditions in which they cannot prove remunerative: this is illustrated in reference to cereal production on land which would give greater profit under olives and almonds.

352. AFRICA. GOLD COAST: *Cotton Cultivation*, 1933-34. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1933-34.) In Togoland, in spite of heavy rains and strong winds, the season showed an increase in the cotton available for export, although the yields on Kpeve Experimental Station were practically nil. Owing to low prices, exports of cotton have declined during the last five years. The Government has made definite attempts to stimulate cotton in the Yam country by means of co-operative societies, and this year, although the numbers of the societies were fewer, more cotton has been planted, all of the Ishan type. Farmers are now satisfied as to the superiority of this type over the local variety, and maintain their own seed supplies.

In the current season the cotton is reported to be growing satisfactorily, and a better crop is expected than in the last few seasons.

In the Northern Territories prices remained too low to make cotton growing for export profitable, but the improved strain produced by selection by the Agricultural Department was maintained on a small scale.

353. KENYA: *Cotton Cultivation*, 1933-34. (*Ann. Rep. Dept. of Agr.*, 1933.) The output of cotton during the year under review was a record for the Colony. The total quantity of lint ginned was 2,700,000 lb., compared with 1,710,773 lb. in the previous year and 694,183 lb. in 1931-32.

Nyanza Province.—This province produces about three-quarters of the total crop grown in the Colony. Rotation crops for cotton are being studied, and yields obtained following a crop of finger millet have been particularly good in North Kavirondo. The quality of the crop, which is grown from Uganda seed, has improved considerably.

Coast Province.—Here, too, the area under cotton was extended and a record crop obtained. The proportion of second-grade lint was higher than usual, partly on account of drought, and partly owing to the fact that a number of natives were growing the crop for the first time.

354. NYASALAND: *Cotton Cultivation*, 1933. (*Ann. Rpt. of Dpt. of Agr.*, 1933, recently received.) The total production of seed cotton was 3,079 tons, an increase of 381 tons over the previous year. U.4 seed was issued, but some system is necessary to check the seed waste that goes on. Most of the crop was purchased by the British Cotton Growing Association. The season was not a particularly successful one owing to short rains and locust damage.

At the Domira Bay Experiment Station good results were obtained in the first season, proving the suitability of this area for cotton. The average yield was 250 lb. lint per acre over the entire acreage, and a stock of seed of improved U.4 types was provided sufficient for an area of not less than 1,000 acres.

355. COTTON GROWING IN NYASALAND. By H. C. Ducker. (*Times Trade and Eng.*, April, 1935, p. xx.) Since 1925 cotton growing in Nyasaland has changed from a European to a native industry, the European now being the middleman, buying, ginning, and shipping the native's produce. The development of transport facilities by the recent extension of the railways has resulted in new areas being opened up, and it is estimated that some 200,000 acres are now available which might be planted to cotton annually. At a conservative estimate this would produce 50,000 bales of lint.

The Nyasaland Government are actively encouraging development by the provision of seed stocks, by investigatory work into the problems of production, and by propaganda. This work is being carried out in conjunction with the Empire Cotton Growing Corporation, whose Cotton Experiment Station at Domira Bay forms a centre for research work, and provides a basic seed supply for all the most important cotton-growing areas. The Government and the

Corporation share the costs of this Station, and the staff is supplied by the Corporation.

The Nyasaland cotton crop is now entirely of U.4 type, derived from the U.4 variety originated by Mr. F. R. Parnell, of the Empire Cotton Growing Corporation's station at Barberton, South Africa. The cotton has the special merit of jassid resistance, produces a readily saleable class of lint, and can give very high yields under Nyasaland conditions. Selection work is being carried out at Domira Bay with a view to making this variety even more suitable for Nyasaland conditions.

Valuable assistance has been rendered to the industry by the British Cotton Growing Association in maintaining the market for the crop during the difficult years caused by the slump in cotton prices.

In conclusion Mr. Ducker writes: "It is believed that the cotton crop has been established on sound lines in Nyasaland, and that its future is bright. It should do much to assist in improving the economic status of the Nyasaland native, and to enable the country to pay its way."

356. SOUTHERN RHODESIA: *Cotton Cultivation*, 1933-34. (*Rpt. of Secy. Dpt. of Agr. and Lands*, 1934.) There was an increase in production due to the prospect of slightly better prices and a reduction of ginning charges. The Bindura and District Co-operative Ginnery, Ltd., operated throughout the season, and their policy of reducing ginning charges to 1d. per lb. was much appreciated by cotton growers.

Mr. G. S. Cameron, the Corporation's Cotton Specialist, reports that American bollworm attacks in the Mazoe and Lomagundi districts were more serious than at Gatooma, especially in late-planted crops. In the light of evidence collected, it is increasingly clear that cotton must be planted before maize. Much damage was caused to cotton by stainers.

The season under review was the best yet experienced at the Cotton Breeding Station at Gatooma. Very satisfactory results were obtained from the two strains 64/7/10 and 64/V. Nearly six tons of seed of these two strains were issued to growers. Owing to the additional funds supplied by the Empire Cotton Growing Corporation for the work on insect pest investigation, results of far-reaching importance may be looked for. The development of cotton-growing among natives is being continued.

357. SOUTH AFRICA: *Cotton Cultivation*, 1933-34. (*Ann. Rpt. of Emp. Cott. Growg. Corpn.*, 1933-34, issued 1935.) The rise in price was the main factor causing farmers to extend their acreage last year, and in spite of many set-backs, such as damage caused by floods in the Orange River area, the crop was over 30 per cent. larger than in 1932-33. Farmers throughout the Union were, however, mainly preoccupied in trying to save their maize crops from the worst locust attack for many years, and the Department of Agriculture engaged in a vigorous campaign with a view to helping farmers to deal with the menace, and considerable success was achieved in protecting the crops.

At the Corporation's Experiment Station at Barberton, the cotton crop experienced both bollworm and drought in an intensive degree, but the season provided a most satisfactory test of the power of recovery of the selections made in the past few seasons from the parent U.4 variety. The bollworm attack coincided with the period of drought: the greater part of the crop that had set was lost, all growth ceased, and serious wilting set in. The situation was then relieved by rain, and the selections from U.4 recovered so remarkably that ultimately the crop was one of the best of recent years as regards both yield and grade. Work is being carried on assiduously on the principal insect pests, American bollworm and stainers, in the hope that some practicable means of control may

possibly be devised as a result. Investigations on possible rotation crops with cotton have been continued, and certain varieties suited to local conditions are now known definitely.

Prospects for 1934-35.—It is reported that a larger acreage has been planted in all areas, and in the Barberton area has been increased by about 30 per cent. Planting conditions generally were fair, and the season was satisfactory in the early months.

358. SWAZILAND: *Cotton Cultivation*, 1933-34. (*Ann. Rpt. of Emp. Cotton Growg. Corpn.*, 1933-34, issued 1935.) A promising start has been made with the introduction of cotton as a native crop, and if the effort is successful it will have considerable value in the development of native agriculture, apart from its cash value. Native cotton demonstrators are being trained at the Corporation's Experiment Station at Bremersdorp; they are then posted to different sections of the native area, where they cultivate small plots for themselves, practising a simple rotation with simple equipment, and visiting and advising others who are interested in cotton and in general agricultural improvement. In the present season there has been a considerable increase in the number of natives who have applied for cotton seed, notwithstanding that severe locust invasions were threatened, and the natives' chief concern was for the security of their food crops.

At the Experiment Station at Bremersdorp the rainfall was high and well distributed in 1933-34, and the conditions afforded an opportunity of testing the strains of the various crops under conditions of high rainfall, compared with the drier seasons of the past few years. A feature of the variety trials of cotton was the success of the earlier strains, which under the conditions of recent seasons had not shown up so well.

359. UGANDA: *Cotton Industry*, 1934-35. (*Crown Colonist*, April, 1935, p. 178.) The 1934-35 cotton crop is not expected to exceed 240,000 bales. East of the Nile the crop has been disappointing, but the crop on the other side is excellent, both in quality and staple. With the market fairly steady at 57 cents per lb. for first-class ginned cotton, growers have been receiving an average of Sh. 13 per 100 lb. for their raw cotton. The export tax collected during 1934 amounted to £110,189, as compared with £58,189 for the previous year.

360. *Cotton Industry*, 1934-35. A report from H.M. Eastern African Dependencies' Trade and Information Office states that the Government's arrangements with regard to prices have worked very successfully except for a little difficulty in a few cases. Natives appear satisfied with the prices paid, and there has been very little dissatisfaction expressed with regard to the combines. Under the Pool arrangements there is still competition, within limits, between buyers, and as much as 15s. per 100 lb. was paid for a few days by one ginner in the Masaka District. The Pool agreements provide a check against over-buying, and there is a penalty for under-buying. Each ginner is thereby encouraged to buy the amount of his share in the Pool at a reasonable figure. The existence of Pools has also led to a more moderate use of lorries in the collection of seed cotton for transport to the buying points. The law prohibiting more than 80 lb. being put in a bag has been well observed by the growers in the Eastern Province. Steel yardarms have been in use in some zones, and have been favourably received by the growers.

361. *Cotton Experiments*. (*Bull. of Imp. Inst.*, xxxii., **4**, 1934, p. 592.) An account of the work carried out at Serere Plantation on the 1933-34 cotton crop is contained in the half-yearly report for the period January to June, 1934.

The derivatives of Parnell's U.4 once again showed themselves to be high-yielding, early-maturing strains with good habit and a high degree of resistance

to both jassid and blackarm. Although some strains gave a staple as long as "East African," none gave lint of quite the same character as that variety. The Nariama strains, derived from S.G.29, showed resistance to blackarm, but were low-yielding and more susceptible to jassid. The lint had the character of "East African," but the staple was shorter. Two series of Harland's hybrids between U.4 and other varieties, sent from Trinidad, were tried in the breeding-plot, and the first series, particularly those hybrids containing elements of U.4, Cambodia, and Jamaica Xerophytic, showed great promise.

Other work carried out at the Station included varietal, sowing date, spacing and dusting trials, spraying experiments for the control of Lygus on cotton, and manurial, rotational, and soil erosion experiments.

The report on the work carried out at the Bukalasa Experiment Station during the same period was as follows:

"The cotton-breeding work has proceeded on the same lines as in previous years, and several new strains in the pedigree lines showed considerable promise. In the variety trials, S.G. 23/8 showed superiority to Local in lint yields, and on account of its very much better spinning qualities it is probably a better cotton than Local.

"The mulching of August-sown cotton with elephant grass gave a significant increase in yield over control, but the high cost of mulching more than cancelled out the value of the increase in the crop. The residual effect of the mulch will be tested next season.

"A test of the effect of rotted cotton seed, green manure in the form of *Crotalaria juncea*, and a combination of the two on a cotton-groundnut-sweet-potato-cotton rotation was laid down this season. Cotton seed alone and cotton seed with green manure gave significantly increased yield over green manure alone and control. No difference between green manure and control was obtained. Apart from its effect on yield, cotton seed has a distinctly early maturing effect on cotton. The residual effect will be tested on groundnuts and sweet potatoes."

362. NIGERIA: *Cotton Ginneries.* (*Crown Colonist*, March, 1935, p. 133.) It is reported that the cotton ginnery at Challowa in the Kano Province, which has been closed for some years, is to be re-opened.

363. AUSTRALASIA. QUEENSLAND: *Cotton Cultivation*, 1934-35. (*Queens. Agr. J.*, February, 1935, p. 189.) Seasonal conditions have been favourable as a whole, and the fields are in a satisfactory state of cultivation. Good yields are anticipated.

364. WEST INDIES. SEA ISLAND COTTON INDUSTRY. (*West Ind. Comm. Circ.*, l., **955**, 1935, p. 185.) In the Report of the Executive Committee of the West India Committee for 1934-35, it is stated that the statistical position of Sea Island cotton showed further improvement during the period under review, stocks in the United Kingdom being reduced to almost negligible proportions. New uses for Sea Island yarn are being found, and now that production in the West Indies is being regulated by the West Indian Sea Island Cotton Association the outlook for the industry is more favourable than it has been for many years. Steps are being taken to register a certification mark for Sea Island cotton goods, to the desirability of which the West Indian Committee first called attention in 1925.

365. ST. VINCENT: *Cotton Prospects*, 1934-35. A note on the cotton crop for the quarter ended December 31st last, received from the Agricultural Superintendent, is to the effect that "the area planted in September and October, according to returns, is 1,464 acres of Superfine Sea Island and 652 acres of Marie Galante. The season has been very favourable in most districts, but owing to low prices cultivation is often somewhat neglected. A fair amount of boll-shedding occurred

in December, but insect pests have been very scarce. No pink bollworm or caterpillars have been reported, and the incidence of stainers has been very low. The yield is expected to be better than that obtained last year."

COTTON IN EGYPT.

366. Features of Egyptian Cotton during 1934. (*Int. Cott. Bull.*, xiii., **50**, 1935, p. 203.) In many respects the year was a good one for Egyptian cotton. Approximately 8,600,000 kantars were exported, an increase of 850,000 kantars over the previous year. All Government stocks were finally disposed of, and the average price-level was $13 per kantar, compared with $11¾ in 1933. The production of Giza 7 was estimated at over a million kantars, compared with 350,000 kantars in the previous year. Legislation was introduced by the Government to check the practice of mixing different varieties of cotton.

367. The Possible Extension of Cotton Cultivation in Egypt. By H.E. Nagib Bey Ibrahim. (*Egyptian Cotton Year-Book*, 1933-34, p. 59.) It is considered that the irrigation and drainage projects now in hand will, in the next twenty years, increase the area under cultivation by 410,000 feddans now absolutely fallow; add to the cotton area by conversion from basin into perennial, or from one crop into more than one crop-bearing lands, an area of 500,000 feddans; improve the irrigation and drainage of 4,300,000 feddans now under perennial irrigation, with a consequent increase in the yield.

368. The Egyptian Cotton Variety Problem. As seen from Giza. By C. H. Brown. (*Egyptian Cotton Year-Book*, 1933-34, p. 50.) It is considered that Ashmouni will survive in the district between Cairo and Assiut, where it is the only variety grown. It is possible that Sakha 4 and Giza 26 will supplant Sakel. The problem of the medium stapled cottons is also discussed.

COTTON IN THE UNITED STATES.

369. America: *Economic and Trade Conditions in the United States*, 1934. By H. O. Chalkley. (No. 600, Dept. of Overseas Trade.) We have received from the Dept. of Overseas Trade a copy of this report dealing with the finance, trade, agriculture, industry, transportation and communications, labour and social questions, and recovery legislation and administration. An account is given of the operations of the Agricultural Adjustment Act, 1933, and the Bankhead Cotton Control Act, 1934, for the reduction of cotton acreage.

370. Use of the Official Cotton Standards of the United States. By J. W. Wright. (*U.S. Dpt. of Agr. Bur. of Agr. Econ.*, Washington, D.C., 1934.) This report covers one phase of a broader study of the use of the official standards by various groups in the cotton industry. The various sections of the report are headed: Sources of data; Marketing channels through which domestic mills procure raw cotton; Means employed by domestic mills for specifying requirements with respect to quality; Extent to which official standards meet mill needs; Extent to which cotton meets purchase specifications; Methods of making adjustments for cotton not conforming to purchase specifications; Summary and conclusions.

371. American Cotton Difficulties. By C. T. Revere. (*Int. Cott. Bull.*, xiii., **50**, 1935, p. 185.) The author discusses the necessity for attacking the cotton problem as a whole; the improvement in the financial position of the Cotton Belt brought about by the reduction of acreage and the drought; the effect of the Agricultural Adjustment Act programme; the need for recapturing America's position in the world cotton markets; the question of compensatory payments to growers.

372. NEW MEXICO: *Results of Irrigation Treatments on Acala Cotton Grown in the Mesilla Valley.* By A. S. Curry. (*New Mexico Sta. Bull.* 220, 1934. Abstr. from *Exp. Sta. Rec.*, 72, 1, 1935, p. 39.) The effects of seven irrigation schemes, involving the furrow and the border flooding methods, on the yield and quality of Acala cotton grown on Gila clay adobe, were studied during the period 1925-33. The agricultural and climatic characteristics of the region are described briefly.

For good stands on this soil, planting evidently should precede irrigation. An interval of from 5 to 6 weeks between the first two irrigations seemed to result in good growth conditions. The wide adaptation of cotton as to water was indicated by the similar yields from 4 or 5 applications, and the slightly higher returns from twice as many irrigations. The length of lint was determined largely by moisture conditions early in summer, and apparently was not affected by later water stress conditions. While lint percentage was reduced by water stress in September and later, it was not affected by moisture conditions during other parts of the growing season. Yields were not altered materially by additional irrigation after enough water had been applied to maintain a fairly vigorous growing condition. Growth apparently was not impaired even when the leaves were allowed to wilt slightly for a few days before irrigation. Indications were that withholding water late in the summer would hasten maturity, and *vice versa*, continuing irrigation until late in September could delay maturity with an increase in immature bolls. Practically the same results were obtained from the furrow and flooding methods, although the latter resulted in slightly earlier maturity.

373. NORTH CAROLINA: *Farm Prices of Cotton in Relation to Grade and Staple Length.* By J. G. Knapp and S. L. Clement. (*N. Car. Sta. Bull.* 289, 1934. Abstr. from *Exp. Sta. Rec.*, 72, 1, 1935, p. 124.) Appendixes discuss the methods used in studying local prices, premiums, and discounts, the variability of farm cotton prices, and transportation costs as a factor in local cotton prices.

374. OKLAHOMA: *Applying Science to Agriculture.* This constitutes a report from the Agricultural Experiment Station for the years 1932 to 1934. Descriptions are given of variety tests on cotton, date of planting trials and spacing experiments. Mention is also made of the improvement in cotton that has been effected by the selection work carried out at the Station.

An analysis is given of the operations of the ginning factories in the State, including the cost of ginning over a period of eight years. There is also an interesting comparison of the economics of snapping cotton as compared with hand picking. The figures comparing the seasons 1932-33 and 1933-34 show that in the 1932-33 season it cost an average of 43 cents per bale more to harvest enough seed cotton to gin a 500-pound bale of lint by picking than it did by snapping. Yet it cost \$2·26 more to gin the snapped cotton than the picked cotton. This left a cost of \$1·83 per bale more for snapped cotton than for picked cotton. But, in the 1933-34 season, it cost \$1·66 more to harvest enough seed cotton to gin a standard-size bale of picked cotton than it did snapped cotton. It cost \$1·38 more for ginning the snapped cotton than it did the picked cotton. The wider spread between the cost of harvesting picked and snapped cotton and the narrower spread between the cost of ginning picked and snapped cotton during the 1933-34 season, compared with the 1932-33 season, were largely responsible for the difference in the total costs.

Tables are also given comparing the prices received for picked and snapped cotton respectively in the two seasons named.

375. TEXAS: *Agronomic Research.* By E. B. Reynolds *et al.* (*Texas Sta. Rpt.*, 1933. Abstr. from *Exp. Sta. Rec.*, 71, 6, 1934, p. 762.) Experiments briefly reviewed include varietal, breeding and cultural tests with cotton; development

of cotton varieties adapted to mechanical harvesting; inheritance studies; technique of crossing and asexual propagation of cotton; fertilizer, irrigation, and rotation tests; effect of fertilizers on length of cotton fibre; effect of previous cropping and of zinc sulphate on cotton yield; fertilizer experiments in control of cotton root-rot.

376. Cotton Growing under Irrigation in the Wichita Valley of Texas. By C. H. McDowell. (*Texas Sta. Bull.*, 494, 1934. Abstr. from *Exp. Sta. Rec.* 72, **2**, 1935, p. 176.) Variety, fertilizer, spacing, delinting, and irrigation experiments made with cotton at Iowa Park during the period 1927-33 are reported, with recommended production practices and comments on climatic conditions, and on the incidence and control of cotton insects, cotton root rot, and angular leaf spot. Varieties outstanding in yield and quality of staple included Delfos, D. and P.L. No. 10, Qualla, Ferguson 406, Missdel, and Acala. Fertilizers increased yields about 11 per cent. on the average, but the increases usually were unprofitable. Manure returned the largest gains, and its moderate use is advised because it also improves the physical condition of the soil. Heavy irrigations with from 2-3 acre-in. of water at longer intervals gave better results than frequent light applications.

COTTON IN FOREIGN COUNTRIES.

377. China: *The National Agricultural Research Bureau: Its Scope and Work.* (Pubd. by the Nat. Agr. Res. Bur., Min. of Industries, Nanking, China. Misc. Pubn. No. 1, 1934.)

378. Crop Reporting in China, 1933. (Pubd. by the National Agr. Res. Bureau, Min. of Industries, Nanking, China. Special Pubn. No. 1, 1934.) The first issue of this contribution from the Dept. of Agricultural Economics gives an interesting account of the system of crop reporting in China, which is already reaching considerable dimensions, with 4,000 reporters

379. Directions for Cotton Improvement in China. By H. H. Love. (Pubd. by the National Agr. Res. Bureau, Min. of Industries, Nanking, China. Special Pubn. No. 7, 1934.) An interesting general account of the various ways in which cotton may be improved. The various sections are headed: Better varieties; Making selections; Care of seed; Laboratory study and seed preparation; Plan of planting; Field methods for the first, second, third, fourth, and for the fifth, or the advanced, test; Hybridization; Conclusions. Details are given of all the work to be done under each heading.

380. A Regional Test of Cotton. By H. H. Love and Y. S. Chen. (Pubd. by the National Agr. Res. Bur., Ministry of Industries, Nanking, China. Special Pubn. No. 3, 1934.) Regional tests have been initiated by the National Agricultural Research Bureau, Nanking, for the comparison of Chinese and foreign cottons in different regions, and this report contains the result of the first year's working. The methods employed are described, but it is pointed out that the experiments must be continued for at least two more years before final recommendations can be made.

381. Dutch Cotton Industry Development. By J. F. Straatman. (*J. Soc. Dyers and Col.*, **51**, 1935, p. 45. Abstr. from *Summ. of Curr. Lit.*, xv., **7**, 1935, p. 192.) The consumption of raw cotton in Holland is steadily increasing at a greater rate even than in Japan. Holland has developed her cotton industry into vertical units, the ultimate aim of each form being to have all processes, from spinning to marketing, performed on its own premises.

382. Association Cotonnière Coloniale. *Bull. No.* 18 contains the following papers: *Les Irrigations du Niger*; *Notre coton en Afrique Equatoriale Française*

(Manue); *A propos de la culture cotonnière en U.R.S.S.* Notes are also included on cotton in the French Colonies and other cotton-growing countries, cotton legislation, marketing, etc.

383. COTTON: CULTIVATION IN HUNGARY. By G. Havass. (*Faserforschung*, **11**, 1934, p. 166. Abstr. from *J. Text. Inst.*, xxvi., **2**, 1935, A69.) It is pointed out that the climate of Hungary does not satisfy all the requirements for cotton cultivation. The many attempts made since 1783 are reviewed. Trials have been made with Asiatic, American, Egyptian and Indian cottons, but with very little success.

384. SOME ASPECTS OF INDUSTRIAL DEVELOPMENT IN JAPAN. (*Int. Cott. Bull.*, xiii., **50**, 1935, p. 258.) A report by Fernand Maurette, Assistant Director to the International Labour Office, Geneva, of a visit to Japan in 1934, when he inspected various establishments—namely, cotton spinning and weaving firms, iron factories, glass works, etc.

385. JAPANESE COTTON INDUSTRY: DEVELOPMENT. By K. Pritzkoleit. (*Wirtschaftsdienst*, **20**, 1935, p. 94. Abstr. from *J. Text. Inst.*, xxvi., **4**, 1935, A226.) A brief account of the development of the cotton industry in Japan, from 6,000 spindles in 1859 up to its present proportions. Statistics are tabulated.

386. JAPANESE COTTON GOODS: EXPORTS TO ABYSSINIA. By G. Rotherburg. (*Wirtschaftsdienst*, **19**, 1934, p. 1722. Abstr. from *Summ. of Curr. Lit.*, xv., **2**, 1935, p. 39.) Japan controls about 80 per cent. of the imports of cotton goods by Abyssinia, and about 50 per cent. of all imports. Reference is made to the possibility of Japanese settlers having about 100,000 hectares under cotton cultivation in Abyssinia within a few years.

387. EGYPTIAN COTTON: PURCHASE BY JAPAN. By J. L. Mackay. (*M/c. Guar. Coml.*, **29**, 1934, p. 465. Abstr. from *Summ. of Curr. Lit.*, xv., **2**, 1935, p. 39.) Attention is called to the threat by Japan in the fine-spinning industry due to her policy of purchasing cotton when prices are favourable instead of waiting until yarn is sold. Last season Japan purchased large quantities of Maarad cotton at about £100 to £150 less per 100 bales than Sakel; Lancashire bought very little, and now Maarad and Sakels are £300 to £400 dearer. Nahda was also £100 to £130 cheaper than Sakel last season. Both Maarad and Nahda are said to be superior to this season's Sakel.

388. JAPAN'S FIRST COTTON MILLS. (*Text. Rec.*, lii., **625**, 1935, p. 24.) It is stated that the first cotton mill was purchased from Lancashire in 1865, and the second mill was built in Japan by a Japanese business man in 1872.

389. COTTON CULTIVATION IN PERU. By D. Windel. (*Egyptian Cotton Year-Book*, 1933-34, p. 91.) A brief outline of the history of cotton cultivation in Peru.

390. LONG STAPLE COTTON IN U.S.S.R. (*Int. Cott. Bull.*, xiii., **50**, 1935, p. 208.) In 1934 an area of over 270,000 hectares was planted to varieties giving a staple of 29 and 30 mm., and even longer, as against 79,000 hectares in 1933.

SOILS AND MANURES.

391. IMPERIAL BUREAU OF SOIL SCIENCE. (*Rpt. for the Year ended March* 31, 1935.) The increasing value of the index of soil science prepared by the Bureau becomes more apparent every year, and the circulation of their publications has expanded. Two technical publications: No. 30, "The Determination of Exchangeable Bases in Soils," and No. 31, "Soil Deficiencies and Plant Diseases," and the late Sir J. B. Harrison's monograph, "The Katamorphism of Igneous Rocks under Humid Tropical Conditions," have been published since March, 1934. In

addition a bibliography, classified on the same system as the Bureau's index, and consisting of the 5,000 to 6,000 references which have appeared in the first forty-one monthly lists, is being prepared, and will be published in July. The abstract service, initiated in February, 1934, has been very well received, some 250 reprints and specially prepared abstracts being despatched in response to various requests. 104 enquiries were received and dealt with by the Bureau during the year. The Third International Congress of Soil Science will be held in Oxford from July 30 to August 7, 1935.

392. SOILS AND FERTILIZERS. By E. M. Crowther. (Reprinted from *Rpts. of the Progress of Applied Chemistry*, xix., 1934.) A useful review of the progress made during 1934 in the study of soil science. The subject is dealt with under the following headings: The Minerals of Soils and Clays; Ionic Exchange and the Structure of Silicates; Physical Analysis of Soils; Soil Organic Matter; Physiological Aspects of Nutrient Uptake; The Availability of Soil Phosphoric Acid and Potassium; Fertilizers, including Nitrogenous, Phosphatic, Potassium, Lime and Magnesia, Organic Manures; Weed Killers; Methods of Analysis of Soils and Fertilizers, including Colorimetric and other methods.

393. SOIL EROSION. By V. A. Beckley. (*Dept. of Agr. Kenya, Bull. No.* 1, 1935.) The position in Nyasaland, Tanganyika, Uganda, and Kenya is reviewed, and it is stated that a survey of erosion in British East Africa shows that in many parts conditions are approaching those that led the Union Drought Commission to their conclusion that, unless methods were radically altered, desert was in sight. The factors affecting erosion are considered, and soil conservation and anti-erosion measures are dealt with in detail and explained by means of a series of diagrams.

Gully erosion can be controlled by various types of check dams which are described, use being made of straw, either loose or held by stakes, brushwood, wire fences, loose stones, rocks and stakes, logs and posts, or concrete. The use of vegetation is dealt with, Napier, Kikuyu, Star and Rhodes grass being mentioned. *Amphilophis pertusa* is probably the most suitable on black cotton soils, and at the lower elevations *Cenchrus ciliaris* is valuable. Many leguminous plants are worthy of attention; the Kudzu vine has been widely and successfully used in U.S.A. Unfortunately it does not produce seed in the Kenya Highlands and has to be grown from layered cuttings. It is a valuable fodder. Many of the Crotalarias can be used as hedges to slow-up water. Properly sited on mild slopes, contour hedges have in places completely stopped sheet erosion. On steep slopes, unless placed very closely, they only mitigate erosion.

Amongst the plants found useful in Kenya are Mexican Daisy, *Alternanthera*, and some of the Crotalarias. Lucerne, if used, must be planted in two or three rows. *Crotalaria cleomifolia* and *intermedia*, and *Tephrosia vogelii* and *candida*, and vetiver grass, found highly useful in the Seychelles, are suggested. Strip cropping in wide strips on the contour is suggested, a close-growing crop being used between widely spaced crops. In U.S.A. strip cropping is widely used in the cotton areas (cotton alternating with wide strips of closely spaced grain or fodder crops) and has checked sheet erosion on quite steep slopes. Systems of strip cropping could be developed for native agriculture by using a rotation of strips of cereals alternating with some soil regenerative and soil-saving crop.

A number of crops loosen the soil surface, especially on the red loams; water is thus more easily absorbed, especially if the soil is covered with litter. Such plants suited to Kenya conditions are Mauritius, Lima and allied beans, low-growing types of lucerne, wedge and grass pea, everlasting pea, napier grass, and to a less extent Mexican daisy, "McDonaldi," "Babu's Delight," and a few other common weeds.

With regard to cultivation, it is pointed out that on the whole, under conditions of normal rainfall, cultivated soil will erode less than uncultivated soil, but under intense rainfall the contrary will be the case. All implemental cultivation must be at right angles to the slope.

Silt pits, to be effective, must be large enough to deal with the water collecting above them, and should be staggered. On gentle slopes grassing down the bottom of the drain will usually be sufficient to prevent scour. On steep slopes stepped drains will generally be necessary. Various systems of terracing are dealt with in detail, and instructions are given for laying them out, a levelling instrument that gives fairly accurate results and a simple form of water level being described.

CULTIVATION, IRRIGATION, GINNING, USE OF SEED, ETC.

394. THE DEVELOPMENT OF FIELD EXPERIMENTS IN AGRICULTURAL RESEARCH. By T. Eden. (*Trop. Agriculturist*, lxxxiv., Nos. 2 and 3, 1935, pp. 63 and 131.) The object of the paper is to trace the application of scientific method in the field; to show what progress has been made in controlling "minutely and scientifically" the circumstances that are met there; to examine the utility of this method of approach to agricultural problems; and by so doing to provide a background for the methods at present in use.

395. BIBLIOGRAPHY OF STATISTICAL METHODS, CHIEFLY ON THE APPLICATION OF THE ANALYSIS OF VARIANCE. By C. Zinzadze and F. Yates. (Statist. Dept., Rothamsted Exp. Sta., 1933. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 177.) A classified bibliography of the main publications up to the end of 1933 for students who wish to study new statistical methods, and for the advanced statistician who wants to become acquainted with the problems confronting research workers. Special emphasis has been laid on the applications of the analysis of variance.

396. STATISTICAL METHODS FOR RESEARCH WORKERS. By R. A. Fisher. (*Biological Monographs and Manuals*, No. V. Oliver and Boyd, Edin. and Lond., 1934. 5th Edtn. Price 15s. Reviewed in *Plant Breeding Abstracts*, v., **3**, 1935, p. 269.) From this long review we give the following quotation: "In accordance with custom the material of the previous edition has been retained with practically no changes, while several additions have been made." One new section concerns corrections to be applied in multiple regression work, when some of the independent variates are found to be of little interest, and it is desired to omit them without going back and solving again. The section on the Analysis of Covariance has been enlarged to introduce the exact test of significance when real differences in treatment have been imposed.

397. SIZE, SHAPE, AND REPLICATION OF PLATS FOR FIELD EXPERIMENTS WITH COTTON. By E. B. Reynolds *et al.* (*J. Amer. Soc. Agron.*, **26**, 1934, p. 725. From *Plant Breeding Abstracts*, v., **2**, 1935, p. 132.) Two similar blank experiments on cotton, one at College Station, Texas, and the other at Chillicothe, Texas, were carried out in 1931 and 1932 respectively. The analysis of variance technique is used in the interpretation of these results, and tables are given which compare the standard errors of the means of plots of different size and shape, the efficiency of such plots and the estimated number of replications of such plots required to give certain postulated standard errors. Studies on the size of plot from these data (*a*) assuming a constant experimental area, and (*b*) assuming a constant number of replications, yield fairly conclusive evidence concerning the most efficient size and shape of plot for cotton experiments. Two graphs give the relation between the actual and the theoretical effect of

different numbers of replicates at the two centres, indicating what the minimum number of replications should be.

398. One-Variety Community Cotton Production. By E. C. Westbrook. (*Bull.* 449, 1935. Univ. of Georgia, U.S.A.) Deals with the subject as follows: The disadvantages of mixed variety production; One-variety cotton communities in Georgia; Some factors to consider when choosing a community for one-variety production; Community organization; Choice of variety; Source of seed; Obtaining and distributing seed; Ginning arrangements; Marketing one-variety cotton; Handling and storing seed; Maintaining high-quality production; Co-operative agencies.

399. Cotton Seed: Delinting with Sulphuric Acid; Advantages. By R. B. Streets. (*Cotton Oil Press*, **18**, No. 9, 1935, p. 22. Abstr. from *Summ. of Curr. Lit.*, xv., 7, 1935, p. 160.) Sulphuric acid delinting is recommended for the control of angular leafspot and other diseases borne on the surface of the cotton seed. Sulphuric acid delinted seed shows better and more rapid germination, and a saving of seed can be effected as half the usual amount of seed gives a perfect stand, and the plants come up before the soil has had time to bake, crust, or dry out, thus saving replanting. The cost of the delinting treatment is less than the saving from planting less seed.

400. An Inexpensive Machine for Filling the Trench Silo. By E. G. Diseker. (*Circ. No.* 61, Alabama Agr. Exp. Sta. Abstr. from *44th Ann. Rpt., Alabama*, 1933.) Reports the use of a small power feed cutter without a blower, which has sufficient capacity for filling a trench silo. A 4-horse-power gas engine was found to be sufficient for its operations.

401. Cotton Ginning Investigations in U.S.A.: Research in Mechanical Phases of Cotton Ginning. By C. A. Bennett. Some Mechanical Elements involved in Good Ginning. By C. A. Bennett. Some Cotton Quality Elements as Influenced by Ginning. By F. L. Gerdes. (U.S. Dept. of Agric. Bureau of Agric. Economics.)

In a paper contributed to the *International Cotton Bulletin* and abstracted in this Review (Vol. X., No. 1, p. 58), Mr. Bennett gave a general account of the results achieved up to 1932 in the course of the investigations undertaken by the U.S. Government. The first two papers now reviewed were read before the Arkansas and Georgia Ginners' Associations respectively, the first in 1933 and the second last year.

An account is given of the machinery recommended, and the need is stressed, under certain conditions, of adequate drying equipment for the seed cotton. Emphasis is again laid on the necessity for clean hand-picking if highest quality lint is to be obtained. Brush gins and air-blast gins are compared, and the conditions described in which each type is advantageous. Results for both types of gin are given of experiments on the power absorbed, the speed at which the gins are run, and the output, with both loose and tight seed rolls.

In the second paper a detailed description, with a diagram, is given of the drier designed by the Government for treating damp seed cotton, and various combinations of machines for cleaning, extracting and ginning are analyzed. Advice to ginners is also given on the maintenance of an up-to-date plant.

In the third paper Mr. Gerdes gives some account of the work that is being done on the effect of ginning on the quality of the lint. These include studies of colour, length and uniformity of staple, moisture, lint percentages, lint index and seed weights. Reference is made to the effect of moisture in seed cotton on the appearance and grade of the lint and on the ginning process. The benefits of drying seed cotton are also discussed. Some results are given of (*a*) cleaning tests, and (*b*) gin speed and seed-roll density on short staple cotton with normal

moisture content. Certain cleaning tests on short staple cottons showed that the addition of either a unit extractor or a 6-cylinder cleaner to a plant consisting of a double-rib huller air-blast gin with a separator raised the grade of the lint by two-thirds of a grade, while the inclusion of both cleaning units raised it by a full grade. The staple was not affected.

In other experiments the use of a loose seed roll as compared with that of a tight seed roll gave lint of a quality higher by nearly a grade at each of three speeds with an air-blast gin.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

402. Plant Quarantine and Pest Control Problems Common to Mexico and the United States. By A. Dampf. (*J. Econ. Ent.*, 28, **1**, 1935, p. 131.) With a view to the control of pink bollworm, which has recently spread to Florida and Georgia, and still exists in Arizona, New Mexico, and Texas, the author suggests the establishment of a permanent international commission, composed of representatives of the Governments of the United States and Mexico, and also, if possible, of experienced cotton growers of both countries. The proposed commission would not only have to draft a common control scheme for both sides of the border, but would have also to study the most convenient manner to avoid difficulties in the shipment of cotton bales from the infested North American counties through the non-infested States of Mexico to Tampico for sea transportation, and of cotton products, as cotton meal, to the United States from Mexico.

403. Field Book of Insects. By F. E. Lutz. (G. Putnam's Sons, New York, 1935. Reviewed in *J. Econ. Ent.*, 28, **1**, 1935, p. 253.) In a review by E. P. Felt it is stated that the book is packed with interesting information about a large proportion of the species ordinarily met with, and the reader is constantly gaining knowledge of the relation of insects to each other and the world of life of which they form a part.

404. Principali Cause Nemiche delle Piantagioni di Cotone nella Somalia Italiana. By G. Russo. (*Agric. colon.*, 28, No. 11, Florence, 1934. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **2**, 1935, p. 102.) A survey of the insects, fungi, and bacteria observed in 1930 attacking cotton in Italian Somaliland.

405. Peru: Informe Sobre el Viaje de Inspeccion a los Cultivos de Algodon de los Valles de Supe y Pativilca. By C. Paez and C. Lamas. (*Inf. Est. Exp. Agric. Minist. Fom. Peru*, No. 26, Lima, 1934. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **3**, 1935, p. 115.) In the Pativilca Valley, Peru, *Dysdercus ruficollis* L. caused a loss of 30 per cent. of the cotton crop up to an altitude of about 500 feet, and 27 per cent. above this level. In the Supe Valley the loss was 34 per cent. The larvæ of a Tachinid, *Acaulona peruviana*, Tns., and of an unidentified fly parasitized 8 to 35 per cent. of the bugs. Mites were found on more than 50 per cent. of the adults, but did not appear to affect them appreciably. Minor cotton pests observed included *Aphis gossypii*, Glov., which was favoured by relatively low temperatures, and *Gasterocercodes gossypii*, Pierce, which was found on ratoon. The measures advised against *D. ruficollis* include proper timing of sowing and other cultural operations, the eradication of wild food plants such as *Sida paniculata*, on which the pest occurs from April to July, and direct control with suitable sprays or dusts.

406. Tingitoidea affecting Cotton. By F. A. Fenton. (*Canad. Ent.*, 66, **9**, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **12**, 1934, p. 698.) A Tingid subsequently identified as *Gargaphia iridescens*, Champion, was observed in May, 1933, to have caused reddish-brown spots on cotton leaves in Texas. This insect

has also been reported from Colorado, New Mexico, and Mexico. Other Tingids that have been recorded on cotton are *Corythucha gossypii*, F., in the southern United States, Central America, and the West Indies; *Corythaica costata*, Gibson, in Peru; *G. solani*, Heidemann, in Oklahoma; *G. torresi*, Costa Lima, in Argentina and Brazil; *G. subpilosa*, Berg, in Argentina, Bolivia, and Brazil; and *Monanthia monotropidia*, Stal, in Brazil. *G. torresi* was recorded from Brazil by Bondar as *G. bimaculata*, Parshley, which is not known to occur in South America.

407. Pink Bollworm: Control. By S. S. Metalnikoff. (*Coton et Cult. Coton*, **9**, 1934, p. 67. Abstr. from *Summ. of Curr. Lit.*, xv., **3**, 1935, p. 41.) Encouraging results in the control of pink bollworm in Egypt have been obtained with vegetable oil emulsions, particularly an emulsion of cotton-seed oil containing nicotine sulphate and a special emulsifying agent or soap. It is suggested that the newly hatched larvæ spend some time on the plant before penetrating into the bolls, and that the oil emulsions have a suffocating effect on them. The use of powdered materials for repelling the moths produces a noticeable reduction in attack, but is not so effective as oil emulsion treatment. Solutions of arsenical compounds produce only a small reduction in infestation even on repeated application.

408. Pink Bollworm: Bacterial Destruction. By S. and S. S. Metalnikoff. (*C. R. Soc. Biol.*, **113**, 1933, p. 169. Abstr. from *Summ. of Curr. Lit.*, xv., **3**, 1935, p. 41.) In Egypt the mortality of the pink bollworm amounts at certain times to 89 per cent. Three bacteria have been isolated from the dead caterpillars—*Bacterium Ephestiæ*, *B. Cazoubon*, and *B. gelechiæ*. Dry spores were added to a molasses solution which, much diluted, was sprayed over experimental fields. The result was that, compared with the untreated control field, the caterpillar number (count of 100 bolls) was reduced by 50 per cent., whereas treatment with arsenic compounds caused a reduction of only 18 per cent.

409. La Lutte contre le Ver Rose (*Pectinophora gossypiella*, Saund.) par la Désinfection des Graines de Coton au Moyen d'Appareils à Air Chaud. By H. J. Bredo. (*Bull. Agr. du Congo Belge.*, xxv., **2**, 1934, p. 250.) A detailed study of the problem of seed disinfection to control pink bollworm in Egypt and the Belgian Congo. The results obtained in Egypt are discussed, and notes are included on the heating and bagging of the seed. A temperature of 60° C. (128° F.) for five minutes is recommended for disinfection, to be followed by the immediate bagging of the seed for two hours to ensure the complete destruction of all pink bollworm. A thermograph is recommended for the control of temperature.

410. El Curculionido Podador del Algodonero, *Chalcodermus bondari*, Marsh. By A. A. Ogloblin. (*Bol. Minist. Agr. Argent.*, **36**, Buenos Aires, **1934**. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **2**, 1935, p. 92.) This study was made following a report of injury from December, 1930, to March, 1931, to cotton in the Chaco territory, Argentina, by *Chalcodermus bondari*, Mshl., which attacked young plants developing their first branches and caused considerable loss. The author quotes the original descriptions of this weevil and of *C. niger*, Hustache, and suggests that the former may be a synonym of the latter. The distribution of *C. bondari*, which attacks various malvaceous plants, is discussed, and the immature stages described. The adults were rarely seen by day. Their feeding left scattered punctures on the shoots, while the female made a ring of punctures on the flowering shoot above which it cut a canal and laid an egg. The protoplasm and plastic substances that accumulate about the punctures provide food for the larvæ. Infested plants lost both leaves and flower-buds. The larvæ were parasitized by a Pteromalid and by *Eurytoma* sp., and were also infested

by fungi, particularly when pupating. In May, 1931, the author found the weevils to be very scarce on cotton, but much more numerous on *Althæa*. In February, 1933, they occurred in approximately equal numbers on *Althæa* and cotton, but examination of a large number of flowering shoots indicated that they would only reduce the crop by about ¾ per cent. An arsenical spray might be applied if serious injury is threatened. Other proposed control measures are discussed, and it is concluded that the destruction of the undergrowth of malvaceous weeds in the field is likely to be the most efficient, since such weeds are the only food plants during the autumn.

411. Economic Advisory Council. Committee on Locust Control. Sixth Report. (London, H.M.S.O., Cmd. 4962, 1934. Price 1s. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **12**, 1934, p. 700.) A brief review is given of the present outbreaks of *Schistocerca gregaria*, Forsk., in Africa and Western Asia, and of *Locusta migratoria migratorioides*, Rch. and Frm., and *Nomadacris septemfasciata*, Serv., in Africa, from their beginnings in or after 1926 to 1933. The outbreaks of the first two species have been gradually diminishing, though the situation regarding *Schistocerca* in North-West Africa continues to be serious. On the other hand, the outbreak of *Nomadacris* is developing rapidly, and the outlook with regard to it is most menacing.

The second section of the report deals with the locust investigations organized on the recommendations of the Economic Advisory Council by the Imperial Institute of Entomology, as well as of those organized by the Governments of Nigeria, the Union of South Africa, India, France, Italy, Belgium, and Egypt. In the third section, a general programme of further investigations is discussed. The fourth is devoted to the question of controlling flying locusts by clouds of finely divided sodium arsenite discharged from aeroplanes. The preliminary laboratory experiments carried out with this end in view are described in detail.

In the fifth section, an account is given of the international co-operation in anti-locust research, and the sixth and seventh comprise a summary of the scientific results so far achieved.

An appendix gives some information with regard to the fungus *Empusa grylli*, which in 1934 caused epidemics among *Nomadacris* in South Africa, Northern and Southern Rhodesia, and Nyasaland. The available evidence suggests that the outbreaks of the disease have been somewhat local, and cannot be expected to produce a serious reduction in the total number of the swarms.

412. Proceedings of the Third International Locust Conference, London, September 18, 1934. (London, H.M.S.O., Cmd. 4725, 1934. Price 3s. 6d. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., **12**, 1934, p. 704.) Summarizes the papers read at the Conference and the resolutions associated with them. The Conference agreed that the locust problem is essentially the same in all parts of the world, and that all countries suffering from the pest should be invited to attend the Fourth Conference to be held in Cairo in 1936.

413. The Locust Outbreak in Africa and Western Asia in 1933. By B. P. Uvarov. (*Econ. Adv. Coun. Comm. Locust Contr.*, 1934, London, H.M.S.O., 63-80-3. Price 2s. Abstr. from *Rev. App. Ent.*, xxii., Ser. A., **12**, 1934, p. 701.) In continuation of the survey of 1932, the breeding and migrations in 1933 of *Schistocerca gregaria* Forsk., *Locusta migratorioides*, Rch. and Frm., and *Nomadacris septemfasciata*, Serv., are discussed in detail and illustrated by a series of maps. An appendix contains a bibliography of papers dealing with the locust and grasshopper problem, continuing and supplementing the lists published in the previous surveys. (*Cf.* Abstr. 113 and 240, Vol. XI., of this Review.)

414. Contribution à l'Étude du Criquet Marocain, *Dociostaurus maroccanus* Thnb., en Afrique Mineure. By R. Pasquier. (*Bull. Soc. Hist. Nat.*

Afr. N., xxv., **6**, Algiers, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **12**, 1934, p. 702.) An account of field investigations in 1933. A plan is proposed for organizing a regular periodic survey of suspected areas in order to discover incipient congregations and prevent the further development of outbreaks.

415. Invasions des Acridiens en Guinée Française. By B. N. Zolotarevsky. (*Bull. Soc. Hist. Nat. Afr. N.*, xxv., **6**, Algiers, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **12**, 1934, p. 703.) An analysis of available data on the invasion of French Guinea by *Locusta migratoria migratorioides*, Rch. and Frm., from 1928. Records are given of previous locust invasions in 1907, 1919, 1924, and 1925, but the species involved are doubtful. Recommendations for the usual control methods are appended.

416. Note Préliminaire sur *Schistocerca gregaria* Forsk., dans le Soudan Français Oriental. By B. N. Zolotarevsky *et al.* (*Bull. Soc. Hist. Nat. Afr. N.*, xxv., **6**, Algiers, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **12**, 1934, p. 703.) Discusses investigations on the distribution of the solitary phase of *Schistocerca gregaria* which have been carried out in the north-eastern parts of the French Sudan.

417. Report on the Locust Position in the Union of South Africa. (*Dpt. of Agr. and For. S. Afr. Rpt. No.* 50, November 1934.) Deals with the anti-locust operations carried out by the Department of Agriculture against the Brown, Red, Desert, and Migratory locusts.

418. Die Bekämpfung der Heuschreckenplagen. By H. Morstatt. (*Tropenpflanzer*, xxxvii., **10**, Berlin, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **12**, 1934, p. 703.) A brief review of the various measures now employed against locusts.

419. The Destruction and Control of Locust Hoppers. By R. W. Jack. (*Rhod. Agr. J.*, December, 1934, p. 856.) A brief account dealing with Mechanical and Chemical Methods of Control, Application of Poison, and Antidotes for Arsenical Poisoning.

420. The Conditions of Sexual Maturation in the Migratory Locust. By V. P. Pospelov. (*Bull. Ent. Res.*, xxv., **3**, 1934. Abstr. from *Rev. App. Ent.*, xxii., Ser. A, **12**, 1934, p. 675.) After reviewing previous work on the effect of temperature on the maturation of *Locusta migratoria* L., the author suggests that this factor alone is not sufficient to induce sexual maturation in the females. In an experiment in Russia, female locusts caged with males during May-July at 21-40° C. (69·8-104° F.) matured their eggs normally in July and died after ovipositing. In females caged alone under identical temperature conditions, maturation of eggs did not occur until August, when they were allowed to pair with males. The latter mature during the first days of the adult stage. The mechanism of fertilization is discussed, and it is suggested that the maturation of the eggs is connected with the penetration into them of the fertilizing fluid.

421. Nitrogen Fixation Studies with Fungi and Actinomyces. By F. E. Allison *et al.* (*J. Agr. Res.*, 49, **12**, 1934, p. 1115.) Experiments are reported with nine cultures of true fungi, including eight strains of *Aspergillus* and one *Cladosporium*, in which an attempt was made to find experimental conditions under which these organisms could utilize atmospheric nitrogen. The results were negative in all cases. Among the cultures used were four strains of *Aspergillus*, which were obtained from the same source as Schober's, and which he had previously reported as possessing this ability. The results failed to corroborate Schober's results, but are in agreement with the recent findings of Schröder, Kadelbach, and Roberg.

Similar studies with five species of common soil actinomyces, grown in various media, also showed no nitrogen fixation under conditions where excellent growths occurred in the presence of combined nitrogen.

A critical consideration of all the evidence on the subject indicates strongly that nitrogen fixation is, at most, limited to a very few species of the free-living fungi, and the data for these are certainly not conclusive. The evidence that certain mycorrhizal fungi can use atmospheric nitrogen, at least when growing in the roots of the host, is much stronger.

422. A STUDY OF THE COTTON ROOT-ROT FUNGUS (*Phymatotrichum omnivorum*) IN THE SOIL BY THE CHOLODNY METHOD. By E. D. Eaton and C. J. King. (*J. Agr. Res.*, 49, **12**, 1934, p. 1109.) A method is described by which the growth and development of the mycelium of the root-rot fungus (*Phymatotrichum omnivorum*) in the soil under natural field conditions may be observed. Preliminary observations show that (1) Phymatotrichum mycelium was active in the soil at least six weeks before the first symptoms were observed on nearby cotton plants; (2) the growth of the mycelium in the soil apparently was not connected with roots; and (3) the mycelium developed in a clean fallow. Suggested uses of the method in investigations of the root-rot fungus are (1) for biological and control studies; (2) as a means of ascertaining the presence of the fungus in fallow lands, and (3) in studies of its interrelations with other organisms.

423. COTTON CROP LOSSES FROM PHYMATOTRICHUM ROOT ROT. By W. N. Ezekiel and J. J. Taubenhaus. (*J. Agr. Res.*, 49, **9**, 1934, p. 843.) Estimation of the reduction of the cotton crop by *Phymatotrichum omnivorum* root rot is difficult because plants killed by the disease may bear a partial crop, and conditions that favour development of root rot also favour the growth of the cotton plant. In an experimental plot in which the cotton was picked separately from each plant it was found that the numbers of bolls per plant, the weight of lint per boll as well as per plant, and the weight of seed per boll as well as per plant, were all lower with plants that had succumbed to root rot. Normal plants bore an average of 4·61 g. of lint per plant, and the plants with root rot only 2·37 g. Plants that succumbed two months or more before the first picking bore only an insignificant crop; plants that succumbed five weeks before harvest bore only half of a normal crop; while there was no observed loss from the death of plants during the three weeks immediately preceding harvest. The coefficient of multiple correlation of yields, May-June-July-August rainfall, and percentages of plants with root rot (using data from continuous cotton plots for twelve consecutive years), was 0·65 for one plot and 0·62 for another. In one plot the average reduction in yields from root rot was 1·04 times the average percentage of plants killed, and in the other plot it was 0·74 times the percentage killed.

The plot data were analyzed again by pairing the results during the various years, and a corrected correlation between ratios of yields in the two plots with the differences in percentages of root rot of $r = -0{\cdot}83$ was obtained. From this analysis, the percentage reductions in yield due to root rot averaged 1·02 times the recorded percentages of plants that succumbed to the disease.

Two tentative methods for the estimation of cotton crop losses from root rot are suggested. By the first method, the estimated percentage reduction in yield is the sum of the percentage of plants killed by root rot seven weeks prior to picking time plus half of the percentage of plants that succumbed during three to seven weeks before harvest. By the second method, the estimated percentage reduction in yield is the product of the percentage of plants killed by root rot by picking time multiplied by a "loss-estimation ratio." A ratio of 0·9 is tentatively suggested for use in Texas.

The cotton crop losses from root rot in Texas in 1928 were estimated from

data obtained in a survey through 41 counties, and crop-reported estimates from 150 counties. The State was divided into 11 regions according to the prevalence of root rot. Weighted estimates of crop losses in the different regions varied from 0 to 16·8 per cent. For the entire State, the mean weighted estimate of cotton plants with root rot was 8·9 per cent. The estimated reduction in yield was about 8 per cent., equivalent to a loss of about 444,000 bales.

424. Persistent Strands of the Cotton Root-Rot Fungus in Texas. By H. C. McNamara *et al.* (*J. Agr. Res.*, 49, 6, 1934, p. 531.) The ability of the cotton root-rot fungus (*Phymatotrichum omnivorum* [Shear] Dug.) to remain in the soil in a viable and infectious condition for a period of years, even when the fields are planted to non-susceptible crops or kept in clean fallow, has been a problem of much concern to investigators of this disease.

During 1931 and 1932 opportunity was presented on the United States Cotton Breeding Field Station at Greenville, Texas, to study further the habits of the fungus in nature. Extensive searches in the soil for the source of carry-over infection were made in a number of infested plots that had been handled under different cropping and tillage conditions, and that therefore permitted at least a minimum estimate as to the age and character of the carry-over infection.

The colloidal nature of the Wilson and Houston clay soils, in which the examinations were made, presented an unusual opportunity to study both the fungus and the plant-root development in their natural state of growth.

An examination in 1931 and 1932 of a very large number of primary centres of infection in plots planted continuously to cotton revealed the fact that the carry-over infection was not due entirely to sclerotia, and that much of the infection overwintered in the soil as strands rather than as sclerotia.

Examination of a plot that was in clean fallow for the first year yielded numerous viable strands throughout the summer and fall of 1932. These strands were located, as a rule, along the old dead roots of the plants that had been destroyed by root rot a year or more before. In the clean fallows only two cases were found in which the fungus showed signs of growth on dead roots, whereas such growth was profuse in infested cotton plots.

On a plot which had been in oats in 1930 and 1931, and which had been kept in clean fallow after the crops were harvested, viable old strands were found throughout the summer of 1932 in and near primary centres of infection. These strands were found *in situ* upon the decayed remains of the old cotton roots that probably had been destroyed by the fungus three years or more before. In some cases they were occupying the empty root channels left by former plantings. When these strands were removed from the soil and placed in moist chambers, or when they were exposed and reburied in the soil, they readily put out new growth.

Old strands found interlacing a colony of sclerotia in a plot that had been in clean fallow for five years were also viable. The age of the strands associated with colonies of sclerotia could not be determined accurately, as they may have been the product of regenerated growth, from the original colony, subsequent to the fallow treatment.

In contrast to the more deeply seated infections of the south-western United States, the strands at Greenville, Texas, were found most abundant in the surface foot of soil, a position which makes them more accessible to tillage control or to soil disinfectants.

From July 30 to August 13, freshly formed sclerotia were found in abundance in primary centres of infection following 3-year and 5-year clean fallows. Older sclerotia and sclerotial casts were found within a few inches of every group of new sclerotia.

The new growth, which usually took place from the ends of the strands, was

characterized by radiating or parallel growth of elongated cells that freely anastomosed during the early growth stages. As this growth proceeded, the union of cells became less frequent and the more typical acicular branches with right-angled cells appeared.

425. Influence of Soil Moisture on Longevity of Cotton Root-Rot Sclerotia. By C. J. King and E. D. Eaton. (*J. Agr. Res.*, 49, 9, 1934, p. 793.) Sclerotia of the root-rot fungus, *Phymatotrichum omnivorum*, were buried in pots and cans of soil maintained at different moisture contents. One series was air-dry and others were kept at 5, 10, 25 and 28 per cent. moisture. Samples were recovered and tested for germination at monthly intervals for one year. All sclerotia in the dry soil and in that kept at 5 per cent. moisture were dead at the end of three months. Those in the soil at 10 per cent. moisture showed a gradual decline in viability after the first two months, with a small proportion still viable after twelve months. Viability was somewhat better preserved in soils maintained at 25 and 28 per cent. moisture, though behaviour at 28 per cent. was somewhat erratic, suggesting that some sclerotia were injured by other organisms. Spontaneous germination occurred in some of the containers maintained at 10, 25, and 28 per cent. moisture, and in some culture pots the hyphæ penetrated the clay sides and the mycelium developed into extensive mats on the outside. Germination and hyphal growth may take place to a limited extent even under saturated soil conditions where little air is available. Sclerotia were observed germinating in their place of origin in soil cultures several months old, and growth of the resulting mycelium was maintained for several weeks.

426. Catalase Activity in Relation to Age and Viability of Sclerotia of the Cotton Root-Rot Fungus. By C. J. King *et al.* (*J. Agr. Res.*, 49, 10, 1934, p. 897.) The sclerotia or hold-over bodies of the cotton root-rot fungus, *Phymatotrichum omnivorum* (Shear), Duggar, darken as they grow older, so that the colour of the sclerotia gives some indication of their age. Colour is not altogether reliable in this respect, however, nor is it a good indicator of vigour. As a rule the catalase activity of the macerated tissues of root-rot sclerotia declined with age, but no great or abrupt reduction in activity occurred until the sclerotia began to lose germination power. An unusually high catalase activity in samples 5 to 8 weeks old suggests an "after-ripening" process comparable to that occurring in certain seeds, during which the catalase activity reaches its maximum. Catalase activity seems closely parallel to metabolic condition of sclerotial tissues, and might be used as an indicator of their age and as a test for full vigour, declining vigour, or death. Catalase activity rapidly decreases when sclerotia are dried.

427. Some Microbiological Activities affected in Manurial Control of Cotton Root Rot. By C. J. King *et al.* (*J. Agr. Res.*, 49, 12, 1934, p. 1093.) The effectiveness of organic manures in controlling cotton root rot under irrigation conditions has been demonstrated by an experiment which has been conducted at the United States Field Station, Sacaton, Arizona, since 1921.

In 1933 an investigation was made to compare some of the microbiological activities in four quarter-acre plots which had received applications of manure for several years with that in five alternate plots of the same size which received no manure. Determinations were made of the CO_2 evolved from large samples of soil obtained as cylindrical cores from each plot. In the choice and arrangement of the apparatus used in these determinations an effort was made to approximate field conditions in the laboratory. In all determinations the samples from the manured plots evolved CO_2 at a greater rate than those from the unmanured plots. In comparisons between adjacent plots the rate of CO_2 evolution from the manured plots ranged from 19 to 152 per cent. greater than from unmanured plots, and the

results indicate a greater microfloral activity as a result of the increased content of decomposing organic matter. A modification of Cholodny's method of direct microscopic examination was used to obtain a measure of the relative abundance of different organisms in adjacent manured and unmanured plots. Clean microscope slides were exposed in the soil for several days; the various organisms which became attached to the slide were "fixed" and their relative density was measured by a system of grades based on the area occupied by each. Bacteria and actinomycetes in various forms and most fungi were more abundant on the slides exposed in the manured plots. The root-rot fungus, *Phymatotrichum omnivorum*, was more abundant on the slides exposed in the untreated plots.

The tests show that the population of many organisms is greatly increased by large applications of organic matter to the soil. The rapid and prolonged reduction of root-rot activity on the manured plots suggests that the dense population of organisms engaged in breaking down the organic materials developed a soil condition temporarily unfavourable for the growth and activity of the root-rot fungus.

428. LET US CHECK THE LOSSES TO THE COTTON CROP CAUSED BY GUMMOSIS. By V. Serbinoff. (In Russian.) (*Crop Protection*—I. Moscow, 1934. Abstr. from *Rev. App. Mycol.*, xix., 1, 1935, p. 32.) After a brief popular account of the damage done to cotton by gummosis (*Bacterium malvacearum*) the author states that in the U.S.S.R. the disease is most prevalent and severe in Transcaucasia and Russian Central Asia, chiefly in the areas where Egyptian cotton is mainly grown. While local varieties are less susceptible, so far no resistant strain has been found, but in Transcaucasia the King-Karayazskaya 915 strain exhibits the lowest susceptibility. Under Central Asiatic conditions it was determined that the yield ofplants affected with stem gummosis (blackarm) is reduced on the average by 60 per cent. of that of healthy plants, while the yield of plants affected with the angular leafspot form of the disease is reduced by 36 per cent.

Disinfection of cotton seed with sulphuric acid was introduced in the U.S.S.R. in 1930, and field experiments in Central Asia showed that plants raised from treated seed developed 3·7 per cent. gummosis at the first leaf and 4·7 per cent. at the blossoming stages, as against 15·8 and 21·1 per cent. respectively in controls. In further tests the treatment effected by hand (as described in a sheet of instructions now in course of publication) was shown to be financially sound. In view of the costliness of the sulphuric acid treatment, a search was made for cheaper disinfectants, among which dusting with AV (the composition of which is not given), copper carbonate, calcium arsenate, and a few other dusts gave good results, and steeping in a 1 in 100 formalin solution was shown to be very effective. In infected areas seed treatment must be supplemented by flooding of the soil, the removal of infected plant material, deep ploughing immediately after harvest, and careful roguing out of all infected seedlings when thinning the stands in the spring. Insect vectors of the bacterium were not found in either of the two regions examined.

429. STUDIES ON THE WILT DISEASE OF COTTON IN THE BOMBAY PRESIDENCY. By G. S. Kulkarni. (*Ind. Jour. of Agr. Sci.*, iv., 6, 1934, p. 976.) The following are the main conclusions presented by the author:

The cause of the wilt disease of cotton is a strain of the fungus *Fusarium vasinfectum* Atk. It belongs to the group of vascular parasites which are responsible for wilt diseases in cabbage, flax, tomato, water-melon, and many other crops.

The cultural and nutrition study of the fungus does not indicate any marked decrease of the disease with the various soil treatments tried. Variations in the kind of soil, in moisture, in soil reaction are of too little use. Applications of

organic matter (farmyard manure) in heavy doses of 40 tons per acre appear to control the disease in the later stages of the crop.

Temperature studies of the fungus show that it can tolerate a wide range from 20° C. to 40° C. with an optimum at about 28° C., and its thermal death point is beyond 50° C.

The fungus is found to a depth of 20 inches in the soil. The soil temperature below six inches does not rise above an average of 32° C. The fungus, therefore, once introduced, can remain in the soil for a number of years. It has been known to survive for seven years in a field which was not sown with susceptible varieties of cotton during the period.

There appears to be a close connection, however, between the temperature of the soil and the virulence of the disease. The disease is very severe at temperatures between 20° C. and 27° C., decreases at 28° C. to 31° C., and is completely stopped at 32° C. and above. Field experiments based on the results of this study which involved hot weather cultivation, sowing on ridges as against the ordinary practice and change in the time of sowing, have not yielded satisfactory results.

The fungus has not been known to attack any crop but cotton. It has been found that the disease is carried inside the seed, and there is a possibility of the wilt organism being introduced into the soil by way of the seed.

The lines on which future investigations of the wilt problem should be carried out are discussed.

GENERAL BOTANY, BREEDING, ETC.

430. Inheritance of Natural Immunity in Plants, with Special Reference to Breeding of Immune Varieties. By D. Kostoff. (*Z. Zücht.*, A19, 1934, p. 550. From *Plant Breeding Abstracts*, v., 2, 1935, p. 99.) Supported by a bibliography of eight pages, an outline of the present state of genetic research on natural immunity in plants is presented, with a summary of the work that has been done on the nature of plant immunity, environmental factors affecting resistance, and on pathogens and their possible genetic nature.

431. Studies in Growth Analysis of the Cotton Plant under Irrigation in the Sudan. I. The Effects of Different Combinations of Nitrogen Applications and Water Supply. By F. Crowther. (*Ann. of Bot.*, xlviii., October, 1934.) The experiment described studies the effects of water and nitrogen supply on the morphological development and physiological processes of the cotton plant grown under artificial irrigation in the Sudan. Three levels of nitrogen supply (obtained by single and double dressings of ammonium sulphate) were compared for each of three levels of water supply, and the interactions between the factors investigated.

The function of nitrogen in stimulating meristematic activity is clearly brought out from observations on numbers of flowers, numbers of nodes on the main stem, and on the relative leaf-growth rates. The function of water in extension growth is shown by the internode lengths on the main stem, and it is suggested that the effect of water on flower numbers is indirect, through the regulation of extension growth. Net assimilation rate is unaffected by water or nitrogen supply during the main growth phase.

The bolls are found to exert a dominating effect on the whole plant when their development begins. This effect results in cessation of apical growth of the main stem and in the stoppage of nitrogen uptake from the soil, presumably through checking of root growth. The nitrogen supply to the plant, as a whole, is interrupted just at the time of the most serious drain on the nitrogen reserves of the plant by the developing bolls. It is suggested that the cessation of root-

growth operates through interference with the carbohydrate supply to the roots.

The type of interaction between the factors was such that the increase in response to either factor increased with a higher level of the other.

The practical importance of the results, particularly in connection with the necessity for obtaining favourable early growth of the crop, is stressed.

432. A Study of Ammonia and Nitrate Nitrogen for Cotton. II. Influence on Fruiting and on some Organic Constituents. By K. T. Holley *et al.* (*Georgia Sta. Bull.*, 182, 1934. Abstr. from *Exp. Sta. Rec.*, 72, 1, 1935, p. 38.) The continuation of a comparative study of ammonium salts and nitrates as nitrogen sources for cotton dealt particularly with the influence of the source of nitrogen on fruiting and on certain organic constituents of cotton-plant saps. Ammonium salt solutions produced better vegetative growth and decidedly better fruiting in their respective series in three of four cases than did nitrate solutions. The growth-rate was high in all series, and the reaction of the medium was usually between pH 4 and 6. An increased proportion of divalent bases in the solutions improved vegetative growth with ammonium salts, and improved the conversion of nitrate nitrogen.

With conditions favouring carbohydrate formation after absorption, the ammonium ion was converted rapidly into organic nitrogen compounds, and no appreciable accumulation of ammonia nitrogen was noted in the ammonia-treated plants. The nitrate nitrogen was converted into organic forms more slowly than ammonia nitrogen, and there were heavy accumulations of nitrates in the nitrated plants, with the highest concentrations in the saps of the younger, more active conducting tissues. Saps of ammonia-treated plants had higher concentrations of sugar in early-growth stages, but such differences decreased somewhat with age. The nitrated plants tended toward higher water content than those receiving ammonium, especially in the stems and leaves.

While the potential efficiency of ammonium salts as a source of nitrogen for cotton plants was established, the requirements for their utilization seemed to be much more exacting than for nitrates.

433. Relation of Root System to Minimum PO_4 Concentration necessary for Good Growth. By A. L. Sommer. (*44th Ann. Rpt. Agr. Exp. Sta., Alabama*, 1933, p. 17.) A study of the extent of root system as compared with the minimum PO_4 concentration necessary for good growth indicated that, at least for a number of plants, the greater the root surface the smaller is the PO_4 concentration necessary for normal growth. Further evidence was obtained in a comparison of the phosphorus content of the expressed juice of the lower stems and of the young leaves of cotton (small root surface, high PO_4 requirement) and of buckwheat (relatively large root surface, low PO_4 requirement). Both kinds of plants were grown in each of several 1,000 litre containers, and the PO_4 concentrations maintained were 0·8 p.p.m., 3·2 p.p.m., and 12·8 p.p.m. Plants at all concentrations made good growth, but the cotton plants at the higher concentrations were much larger than those at a concentration of 0·8 p.p.m. The expressed juice from the stems of buckwheat contained much more phosphorus than that from cotton. There was much less difference (sometimes a reversal in the relationship) between the phosphate contents of the young leaves of the two kinds of plants. This indicates that there is little or no difference in the amount of phosphorus needed to produce a unit of dry matter of the two plants, and that the rate of growth is limited at low PO_4 concentrations by the rate of supply of this ion.

434. The Value of Single Lock Samples as a Measure of Seed Purity in Cotton. By J. H. Moore. (*J. Amer. Soc. Agron.*, 26, 1934, p. 781. From

Plant Breeding Abstracts, v., **2**, 1935, p. 131.) The inheritance of combed staple length, based on the random selection of a single lock from each parent plant, was studied in order to determine the accuracy of this method in measuring variability of length within a variety of cotton. Four American Upland strains (*Gossypium hirsutum*, L.) with varying degrees of variability of combed staple length served as material. The data from one season's observations showed that the method in question was reasonably accurate. It was, however, also clear that, in view of the fortuitous fluctuations that occurred in the parent samples, the method as applied to the performance of individual plants within a variety of cotton has its limitations in the measurement of combed staple length variation.

435. MAIN PROBLEMS OF SOVIET PLANT BREEDING AND METHODS OF SOLVING THEM. By N. I. Vavilov. (*Semenovodstvo*, **2**, 1934, p. 5. Abstr. from *Plant Breeding Abstracts*, v., **3**, 1935, p. 203.) The main points to which attention must be given in breeding are discussed. Local material should form the basis of all breeding work as much as possible; the application of vernalization is very important. Distant hybridization is stated to be a method with a great future, and interspecific crossing, artificial production of mutations, and co-operation with other branches of biology are also specially dealt with.

In connection with cotton, the crosses between Egyptian and American varieties, when examined critically by the author, convinced him that this work has still a long way to go, and there is as yet no firm proof that it will yield practical results, though the possibility remains.

436. BREEDING RESISTANT VARIETIES (OF CROPS), 1930-33. (Pubd. by Imp. Bur. of Plant Genetics, Cambridge, England, 1935. Price 2s.) A list of titles supplementary to the bibliography on breeding varieties resistant to disease, issued in 1930.

437. SODA STRAWS IN HYBRIDIZING COTTON. By J. O. Beasley. (*J. Hered.*, **25**, 1934, p. 502. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 240.) The use of lint-cotton wrapped round the base of the stigma under the straw is recommended as an easier and more satisfactory method of fastening the straw covering than a paper clip or string.

438. STORAGE OF COTTON POLLEN. By G. J. Harrison and H. J. Fulton. (*J. Agr. Res.*, 49, **10**, 1934, p. 891.) Cotton pollen was stored successfully under refrigeration for two, three, and four days: (1) in buds collected in the afternoon preceding anthesis, (2) in flowers collected in the morning when the anthers were beginning to open, and (3) as loose pollen collected in the afternoon when all the anthers were fully open. Pollen stored in the laboratory at air temperature failed to effect fertilization, whether collected in the bud in the afternoon preceding anthesis, in the early morning when pollen first became available, or in the afternoon when the pollen was fully mature. Pollen stored in a desiccator at air temperature over calcium chloride also failed to effect fertilization. With the three methods of storage that proved successful, each additional day of storage resulted in a material reduction in the degree of fecundation effected, whether measured by the percentage of bolls set or by the number of seeds per boll. No attempt was made to determine the absolute or maximum longevity of cotton pollen. Storage of pollen by refrigeration in the flower collected early on the day of anthesis appears to be the most practical of the three methods.

439. NOTE SUR QUELQUES PROGRÈS RÉALISÉS DANS LES MÉTHODES DE SÉLECTION DU COTONNIER AU CONGO BELGE. By L. Soyer. (*Journées Agron. Colon.*

Gembloux, 1933, p. 167. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 239.) The methods employed for mass and pedigree selection are described.

440. On Agronomic Measures in Breeding. By P. N. Konstantinov. (*Semenovodstvo*, **2**, 1934, p. 46. Abstr. in *Plant Breeding Abstracts*, v., **3**, 1935, p. 203.)

441. Moderne Prinsipper i Planteforedlingen. By G. Hiorth. (*Tidsskr. Norske Landbr.*, 41, 1934, p. 183. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 203.) A general review of modern methods and progress in plant breeding.

442. Planteforedling pa Cytologisk Basis. By K. Flovik. (*Tidsskr. Norske Landbr.*, **41**, 1934, p. 295. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 192.) A survey of recent advances in plant breeding, with special reference to the various aspects of polyploidy and chromosome fragmentation. A bibliography of representative papers is included.

443. Genes and Chromosomes. (*Sci.*, 1934, **80** [Suppl.], p. 8. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 192.) By the aid of X-ray bombardment to induce mutation and by a new chromosome staining technique Professor Muller and Dr. Prokofyeva, working in Leningrad, have succeeded in tracing certain genes to individual chromomeres. The smallest particle of chromosome substance used in the investigation was about one sixteen millionth of an inch in diameter, yet it contained several genes. It is hoped that ultimately particles so small that they can contain only one gene apiece may be detached and used to measure the size of the individual gene.

444. The Problem of Selection for Yield in Hybrid Progenies. By V. Ramanathan. (*Proc. Ass. Econ. Biol.*, **1**, p. 61, Coimbatore, 1934. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 180.) The difficulties in selecting suitable plants at the various stages of selection for yield in hybrid progenies were described, and various possible methods of identifying the best-yielding strains in the shortest time were put forward for consideration and discussion. The question of how the effects of heterosis might best be detected and eliminated received special attention.

445. Mechanical Aspects of Nuclear Division. By C. D. Darlington. (*Sci. J. R. Coll. Sci.*, **4**, 1934, p. 93. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 177.) From a comparative study of meiosis in homozygous organisms it may be inferred that not only are the forces of attraction and repulsion operating at meiosis universally the same in such forms, but they are also the same as those acting at mitosis. The nature and distribution of these forces has been examined by quantitative studies of terminalization of chiasmata, and evidence has been found in favour of the hypothesis of electrical charges on the surfaces of the chromosomes as the basis of chromosome behaviour at prophase and also metaphase and anaphase. Spiralization (and possibly also crossing-over) may, it seems likely, be due to tensions set up in the chromosome threads, as a result of change in the pH. The value of such assumptions in the attempt to elucidate the whole range of chromosome behaviour must be examined in collaboration with the physicists.

446. Chromosomes and Plant Breeding. By C. D. Darlington. (*Proc. Ass. Econ. Biol.*, **1**, p. 80, Coimbatore, 1934. From *Plant Breeding Abstracts*, v., **3**, 1935, p. 177.) Deals with chromosomes in relation to sterility under the three headings: (1) Relational, (2) Morphological, and (3) Generational Sterility. The different types of chromosome behaviour contributing to sterility are also described and exemplified.

447. A NEW TECHNIQUE IN COTTON HYBRIDIZING. SUGGESTED CHANGES IN EXISTING METHODS OF EMASCULATING AND BAGGING COTTON FLOWERS. By C. C. Doak. (*J. Hered.*, 25, 1934, p. 201. From *Plant Breeding Abstracts*, v., 2, 1935, p. 132.) A criticism of the present method of emasculating cotton is followed by an illustrated description of an adaptation of Buchholz and Blakeslee's technique for *Datura* to the cotton plant. The new method (which is in regular use at the Station for Experimental Evolution at Cold Spring Harbour) consists essentially in the removal of corolla and andrœcium in one piece. The advantages of using a lemonade straw closed at one end and fitting tightly round the ovary, instead of the usual bag to protect the flower, are demonstrated.

448. ON THE MUTATING SNAKY COTTON PLANT. By S. Terada and S. Horio. (*J. Soc. Trop. Agr. Formosa*, 6, 1934, p. 4. From *Plant Breeding Abstracts*, v., 2, 1935, p. 131.) The mutants which occurred in 1933 in Upland cotton differ only morphologically and not in vegetative growth characteristics, time of maturity or yield, from the original strain from which they are derived. The main feature of the anomaly is waviness of the cotyledons and young leaves and of the hypocotyl.

449. CYTOGENETIC NOTES ON COTTON AND COTTON RELATIVES. By J. M. Webber. (*Science*, 80, 1934, p. 268. From *Plant Breeding Abstracts*, v., 2, 1935, p. 131.) In the F_1 of some hitherto unrecorded interspecific hybrids between the American cultivated and wild species, the chromosome complement at reduction division was 13 pairs and 13 single chromosomes; in hybrids between cultivated American species and *G. sturtii* from 0 to 4 pairs with from 21 to 39 single chromosomes were found; and in hybrids between wild American species and *G. sturtii* 26 single chromosomes. In addition, hybrids between *G. sturtii* and *Thurberia thespesioides* ($n=13$) have been found to exhibit 26 single chromosomes at first metaphase. These new findings are taken as indicating the allopolyploid nature of American cultivated cottons.

450. SÉLECTION MASSALE DES GRAINES DE COTTON. By L. Cuvelier. (*Jour. Agron. Colon. Gembloux*, 1933, p. 147. From *Plant Breeding Abstracts*, v., 3, 1935, p. 240.) The procedure followed at the Gandajika Station for the mass selection of cotton seed with the object of maintaining the purity of the stock is described.

451. GENETIC RELATIONS OF NANKEEN LINT TO PLANT COLOUR AND LEAF SHAPE IN UPLAND COTTON. By J. O. Ware. (*Bull. Ark. Agr. Exp. Sta.*, No. 300, 1934. From *Plant Breeding Abstracts*, v., 2, 1935, p. 130.) Seventeen crosses were made between plants with Nankeen lint ♀ and with red plant colour and okra leaf shape. Some of the progenies were continued into the F_4, and back-crosses were made with the parental types Nankeen, red okra leaf, green okra leaf, and winesap. The detailed statistical data include the application of the χ_2 test and the calculation of the probability values corresponding to the obtained χ_2 values. The results showed clearly that each character is monofactorial and is independently inherited.

452. A PECULIAR COTTON PLANT. By M. Afzal. (*Curr. Sci.*, 3, 1934, p. 206. From *Plant Breeding Abstracts*, v., 3, 1935, p. 185.) Since the number of seeds in the locules of cotton is a character of some taxonomic importance, details are given of a supposed mutant plant found in a field of *Gossypium indicum*, var. *Mollisoni*, Gammie. Each lock had six or seven ovules, but at its base only one mature seed, and when the bolls matured there was only one sound seed in each loculus, the rest of the ovules being markedly shrivelled. Of the four seeds obtained three germinated well, but all the seedlings died, though not, in the writer's opinion, as a result of the action of genetic lethal factors.

453. AGRONOMIC QUALITIES OF THE NEW COTTON VARIETY "KOLKHOZNIK." By L. Kolojarova. (*Bor'ba za khlopok*, No. 4, 1934, p. 69. From *Plant Breeding Abstracts*, v., 2, 1935, p. 129.) The variety No. 8517, now named Kolkhoznik, was produced at the Central Breeding Station of the SredazNIHI in 1928, by selection from Acala No. 0278. It was handed over for multiplication in 1930, and now occupies 50,200 ha. It is 1 to 2 days later than Navrotskii in beginning to bear, but produces its bolls more rapidly and so completes its yield earlier. It exceeds Navrotskii in yield of raw material by 5 to 10 per cent., in yield of lint by 15 to 20 per cent. Its lint length in 1933 was 29-31, 2-3 mm. above Navrotskii, the average excess for the period 1932-34 for all stations being 3·1 mm. The average weight of the bolls was 120-130 g. compared with 123·1 g. for Navrotskii, though the weight of seeds was slightly lower than in Navrotskii. The lint is strong, soft, and silky, and the combination of length and ginning percentage in this variety is more favourable than in any of the other varieties tested, both properties being notably in excess of Navrotskii. There is every reason why it should replace Navrotskii, though at present it is still apt to segregate slightly, and requires further purification.

454. NEW VARIETIES OF COTTON IN THE FERGANA VALLEY. By — Piscugin. (*Bor'ba za khlopok*, No. 5, 1934, p. 65. From *Plant Breeding Abstracts*, v., 2, 1935, p. 130.) The outstanding variety is No. 8517 Kolkhoznik, but Kim No. 2107 and an Egyptian selection, Pima Ferganskii, also gave very promising results in field tests.

[*Cf.* Abstr. 453, above.]

455. A VARIETY OF COTTON THAT WILL REPLACE NAVROTSKII. By F. Ucevatkin. (*Bor'ba za khlopok*, No. 1-2, 1934, p. 115. From *Plant Breeding Abstracts*, v., 2, 1935, p. 130.) The variety discussed is No. 8517, Kolkhoznik.

[*Cf.* preceding Abstract.]

456. PETALODY IN COTTON. By V. R. Ayyar and R. Sankaran. (*Ind. Jour. of Agr. Sci.*, iv., 6, 1934, p. 938.) Two types of petalody in cotton are described. In one case a few fertile pollen grains are present, but the stigma is devoid of hairs and the lobes become separate. The ovules seem to be fertile. In the other case, the degree of petalody is weak and the anthers are entirely contabescent. The stigma is coherent and bears hairs, though less than the normal. Despite these favourable features no bolls developed even with artificial pollination. It is presumed that the ovules are functionally sterile.

The pollen from the first type was dusted on to the stigmas of normal flowers. In F_1, and subsequent generations, the normal condition of the flower was dominant. This character segregated in a monohybrid ratio, indicating thereby that petalody is caused by single genic difference which is denoted by F^{pd} and f_{pd}.

FIBRE, YARN, SPINNING, WEAVING, ETC.

457. MODERN TEXTILE MICROSCOPY. By J. M. Preston. (Emmott and Co., Ltd., London and Manchester, 1933. Price 15s. Abstr. from *Bull. Imp. Inst.*, xxxii., 1, 1934, p. 180.) The opening chapters deal at length with the microscope, and the type of instrument most suitable for textile work. Other chapters deal with photographic methods of measuring the amount of light reflected or transmitted by a textile fibre, and spectro-photometric measurements. Further chapters are concerned with the investigation of fibres with the ultramicroscope or by dark-ground illumination, the examination of surface structures, and the application of fluorescent light and polarised light to this type of research. The book is well produced, contains 134 diagrams and illustrations, and is provided with an excellent bibliography.

458. Textiles and the Microscope. By E. R. Schwarz. (London: McGraw Hill Pubg. Co., Ltd., 1934. Price 24s. Abstr. from *Bull. Imp. Inst.*, xxxii., **1**, 1934, p. 181.) A large portion of the book is devoted to types of microscopical and photomicrographic apparatus, the accessories for use in textile microscopy and manipulative technique. The remaining chapters deal with the application of polarized light and its importance in the theoretical and practical aspects of textile research, and the use and value of the microscope for the analysis of fabric, yarn, and fibre. The book is copiously illustrated and contains a useful bibliography of some 350 entries.

459. Research Work: Shirley Institute. By F. Scholefield. (*Times Trade and Eng.*, March, 1935, xxiii.) The value of scientific research to industrial requirements, and the work of the Shirley Institute, are discussed.

460. Fibres: Identification. (*Deut. Färber Z.*, **70**, 1934, p. 541. Abstr. from *J. Text. Inst.*, xxvi., **3**, 1935, A164.) Simple tests are described that do not require a microscope or special apparatus, including burning tests and methods for effecting the following distinctions: (*a*) Cotton from flax; (*b*) Silk, rayon and mercerized cotton; (*c*) Egyptian cotton from imitations; (*d*) Silk from wool, (*e*) Woollen from worsted yarns; (*f*) New wool from re-worked wool; (*g*) Various bast fibres; and (*h*) Various rayons.

461. Unit Cell of Cellulose in Cotton Stalks and Cusps. By J. P. Sanders and F. K. Cameron. (*Indus. and Eng. Chem.*, xxv., **12**, 1933, p. 1371. Abstr. from *Exp. Sta. Rec.*, 71, **6**, 1934, p. 890.) Cellulose of cotton stalks and cotton cusps was shown in studies at the University of North Carolina to be the same as that found in cotton lint, spruce, pine, and poplar. The unit cell or fundamental structure is the same irrespective of the origin of the cellulose. Differences in physical properties of products from celluloses of different origins were indicated by X-ray and chemical methods to be due to differences in micelle or fibroid structures.

462. Histological Studies of the Fibre and Seed of Cotton. By D. G. Sturkie. (*44th Ann. Rpt. Agr. Exp. Sta. Alabama*, 1933, p. 12.) This study was commenced in 1929 to determine the origin of the fibre and its development in length, width, and thickness. The successive stages in the development of the seed were also studied. The results are summarized as follows: Cotton fibres originate from the outermost cells of the epidermis of the seed. Most fibres are formed on the day of blooming irrespective of pollination or fertilization. Very few fibres are formed after the third day. In fertilized ovules, rapid elongation of fibre proceeds until the twenty-first day, elongation being completed by the twenty-fourth day. The period of most rapid growth is between fifteen and twenty-one days of age. During this period the fibre is lengthening at the rate of approximately $\frac{1}{25}$ to $\frac{2}{25}$ inch per day. In unfertilized ovules, fibre elongation ceases after the third day. The fibre attains its maximum width by the sixth day after blooming. Fibre thickening does not begin until the fibre has attained its entire length. Thickening of the fibre wall usually begins on the nineteenth day. Thickening is relatively slow until the twenty-seventh day, but after this it is rapid and is generally completed by the thirty-ninth day. Seed growth as regards length and width is practically completed in twenty-one days. The weight of seed increases very slowly for the first ten days, and more rapidly until approximately forty-five days of age. For the first twenty-one days the percentage of lint is variable; during this period the weight of the fibre is proportional to its length, but after maximum length is reached the increasing weight of the fibre is due to the thickening process. From the twenty-second to the fortieth day the weight of a seed and the weight of lint from that seed

increases at the same rate. After forty days the lint ceases to gain in weight, while the seed continues until about the forty-fifth day. This causes a decrease in the percentage of lint after the fortieth day.

463. COTTON: FIBRE PROPERTIES AND SPINNING VALUE. By O. Roehrich. (*Revue Text.*, **32**, 1934, p. 711. Abstr. from *J. Text. Inst.*, xxvi., **1**, 1935, A39.) A method of measuring the rigidity of fibres is described that depends on measurements of the time taken by a twisted bundle of fibres of 10 mm. length to untwist. Determinations have been made on samples of Egyptian, American and Indian cottons. The results are given together with the results of spinning tests and determinations of length and fineness. In certain cases differences in the spinning value of cottons of a given type can be explained by differences in rigidity, but in other cases it is not possible to explain differences in spinning value by differences in rigidity or in other fibre properties. Rigidity appears to be more closely correlated with mean fibre diameter than with fibre weight. It is shown that an approximate estimation of the highest possible counts in spinning can be made from the fibre length and diameter, and an empirical formula is given.

464. THE CALCULATION OF CERTAIN FIBRE LENGTH CONSTANTS IN COTTON. By O. A. Pope. (*J. Amer. Soc. Agron.*, **25**, 1933, p. 740.) Staple length is unsatisfactory for comparison of the small differences with which breeders deal. Not only does its determination depend upon the estimate of the classer, but, as it is only a rough estimate of modal length, it gives no indication of the fibre length distribution within the sample. The use of modal length also has objections, which are specified, and the author suggests that the results of a length analysis by means of the Baer sorter or a similar apparatus are best given on a dual basis of mean fibre length of the fraction of the sample over ½-inch in length, and the percentage by weight of the fibres in the sample that have a length of ½-inch or less.

465. TEXTILE FIBRES: MOISTURE RELATIONS. By Q. Fimiani. (*Textilia*, **9**, 1933; **10**, 1934. Abstr. from *J. Text. Inst.*, xxvi., **1**, 1935, A38.) The hygroscopic nature of textile fibres, the relative humidity of the atmosphere and its relation to the absolute moisture content, and the principles on which hygrometers and psychrometers work, are discussed.

466. SIMPLIFIED MECHANICAL DEFIBRATION OF INDIAN COTTON SEED. By W. E. J. Beeching. (*Text. Weekly*, xv., **372**, 1935, p. 433.) A description of a machine which has been devised to accomplish simply (*a*) the complete removal of the short fibres remaining attached to the seed after treatment in the gin; (*b*) the complete removal of the "fuzz" which is firmly attached to the seed; (*c*) the separation of the "fuzz" from the defibred seed.

467. COTTON HAIR: STRUCTURE AND MERCERIZATION. By W. Schramek. (*Leipz. Monats. Text. Ind.*, **49**, 1934; **50**, 1935. Abstr. from *Summ. of Curr. Lit.*, xv., **7**, 1935, p. 172.) The structure of the cotton hair is discussed with reference to the work of various investigators, and the conclusion is drawn that beneath the cuticle the cotton hair consists of a series of concentric layers built up of crystalline micelles, the micelles within any one layer being cemented together and entwined by more or less unordered chain molecules of cellulose and possibly closely related substances. The changes taking place on swelling and on treatment with caustic soda are described.

468. COTTON HAIRS: LENGTH MEASUREMENT. (1) Anon. (2) N. Ahmad. (*Ind. Text. J.*, **45**, 1934, pp. 47 and 84. Abstr. from *Summ. of Curr. Lit.*, xv., **3**, 1935, p. 54.) (1) A modification of Baer's method enabling a rapid quantitative estimate of the range of different fibre lengths in a sample is suggested.

For each length group the bunches of fibres, instead of being laid out as in the Baer diagram, are weighed, and the mean length calculated from the frequency distribution. In order to get the proper frequency distribution, the combs must be placed 0·125 inch apart, instead of 0·2 inch, as in the Baer sorter. (2) Ahmad states that a modification of Baer's method similar to that described above was not found in his laboratory to be entirely satisfactory, as it gave frequency distributions different from those obtained by other methods.

469. COTTON HAIRS: HAIR ABNORMALITIES AND DENSITY OF MASS IN THE BOLL. By W. K. Farr. (Reprint from *Contr. Boyce Thompson Inst.*, **6**, 1934, p. 471. Abstr. from *Summ. of Curr. Lit.*, xv., **7**, 1935, p. 180.) Few abnormalities are found in hairs of Pima, Super Seven and Acala cotton during the period of development in which increase in size of the boll cavity is keeping pace with enlargement of the fibre mass. Counts of abnormalities from mature bolls of the three varieties show a large number in Acala, a smaller number in Super Seven, and very few in Pima. Upon the basis of the relative weights of walls and partitions and seeds and hairs throughout the entire period of development, a low density of the hair mass is shown in Pima, a greater density in Super Seven, and a much greater density in Acala. It is suggested that the density of the hair mass within the boll during the later stages of development is one of the important factors in the determination of the number of hair abnormalities. Cell enlargement and the formation of a thick cell membrane are two of the more conspicuous phases of cotton hair growth. The tendency to enlarge in an approximately linear direction is inherent. If obstructed in one region of the boll cavity, however, the portion of the hair concerned apparently appropriates any available space in the immediate vicinity for enlargement. This may result in change in diameter, change in direction of growth, or any other of the many different types of abnormalities. The need for such adaptation upon the part of a single hair, and consequently the probability of abnormality formation, will be greater with increasing density of the hair mass.

470. DRY RAW COTTON: SPONTANEOUS HEATING IN AIR. By G. A. LeRoy. (*Bull. Soc. Ind. Mulhouse*, **101**, 1935, p. 123. Abstr. from *Summ. of Curr. Lit.*, xv., **8**, 1935, p. 201.) Raw cotton that has been dried at temperatures between 50° and 110° and cooled in the absence of air absorbs moisture and undergoes a rise in temperature of about 20° on exposure to air of normal humidity. No increase in weight or rise in temperature is observed on exposure to dry air. The conclusion is drawn that the rise in temperature is due to hydration of the cellulose and not to any action of atmospheric oxygen on the fibre.

471. STUDIES OF VARIATIONS IN THE PHYSICAL PROPERTIES OF COTTON. By K. Sen. (Lyallpur, 1934.) A study of variations in the physical properties of cotton fibres induced by (*a*) the position of seeds in a lock; (*b*) climatic changes during the season; (*c*) cultural operations; and (*d*) ginning.

472. COTTON STAPLING APPARATUS. (Ind. Cent. Cott. Comm., Bombay, India. E.P. 420,960 of 14/5/34: 11/12/34. Abstr. from *Summ. of Curr. Lit.*, xv., **2**, 1935, p. 31.) A method of determining the mean fibre length of raw cotton or other textile fibres consists in taking a representative sample of the fibres, combing it out, selecting therefrom a bunch of fibres with aligned ends, the ends of uneven length being all at the further end of the bunch, cutting off a measured length of the bunch from the aligned end and also a measured length from the centre of the bunch by dividing the bunch at two points, thereby forming three groups, weighing the three groups separately, and calculating the average length of the uneven ends in the third group by comparing its weight with the weight and known lengths of the first group, and adding this calculated length to the known

lengths of the first group and the middle group to give the mean length of the fibres in the bunch. The mean weight per unit length of the fibres is determined by first ascertaining the mean length by the above method, then counting the number of fibres in the sample, and finally dividing the total weight of the three groups by the mean length and by the total number. Apparatus for ascertaining the mean fibre length and/or the mean fibre weight per unit length by the methods described comprises a slide bed, a carriage mounted on the slide carrying a tweezer thereon, means for causing the tweezer to engage and hold the fibres securely, means for traversing the carriage on the bed to draw out fibres from a sliver and/or to draw said fibres through a comb or combs, at one end of the slide bed. A cutting device in the shape of two cutting knives or razor blades mounted in such a manner that they will cut the stretched bunch of fibres simultaneously along two parallel lines at the desired distance apart is provided.

473. STANDARD COST CONTROL FOR COTTON SPINNING. By J. Ryan and J. S. Taylor. (Pubd. by the Harlequin Press Co., Ltd., Manchester. Price 5s. net. Abstr. from *J. Text. Inst.*, xxvi., **2**, 1935, P26.) The authors have written an exhaustive treatise in which they reveal an intimate knowledge of the technique of cotton spinning and accountancy. It is a mine of information to the student, and full of suggestions to the more advanced who may wish to assemble details of costs with greater accuracy.

474. NEP FORMATION IN CARDING. (*Text. Weekly*, xv., **368**, 1935, p. 322.) The writer states that "to avoid neps the film of cotton on the cylinder must be kept as thin as possible, and a way of doing this is to set the doffer closely to the cylinder. It is also clear that the fact of neps being found centred on seed-coat, etc., does not necessarily absolve the carder from blame or throw responsibility on to the cotton, as at first sight such an observation would do. This is a point of first importance to those engaged on the thankless task of delving into the causes of defective production, and must be taken carefully into consideration before condemning the cotton when neppy webs arise, particularly on changing over from the coarser to the finer cottons."

475. SOME ASPECTS OF HUMIDIFICATION RELATING TO COTTON MILLS. By J. H. Hall. (*Text. Weekly*, xv., **357**, 1935, p. 17.) A report of a lecture giving brief accounts of instruments for measuring humidity, the effect of humidity on cotton fibre, and different methods of humidifying.

476. SIMPLIFIED COTTON-SPINNING SYSTEM. (*Revue Text.*, **32**, 1934, p. 787. Abstr. from *J. Text. Inst.*, xxvi., **2**, 1935, A72.) In the system described it is possible to work mixtures of inferior quality cotton with cotton of long staple.

477. AMERICAN COTTON MILL INCREASED PRODUCTION EXPERIMENTS. By R. C. Nyman. (*Mech. Eng.*, **57**, 1935, p. 73. Abstr. from *Summ. of Curr. Lit.*, xv., **7**, 1935, p. 191.) At the Pequot mills (U.S.A.), five years ago, the management and labour union entered into a plan for co-operation in reducing production costs. A Joint Research Committee of mill and union executives, with a joint research staff under its direction, was established. Its purpose was twofold: (*a*) To discover to what extent the job assignments of the workers could be increased; (*b*) to devise new labour-saving methods, etc. In its first set of problems it had limited and temporary success, but on approaching the second set there was resistance from both workers and management. The labour extensions yielded an annual saving in labour expense of approximately $200,000, whilst at the same time average wages were increased by 15 per cent., operating and working conditions were improved, and dismissals were confined to temporary workers. The antagonism of the workers steadily increased, however, and the situation was further complicated by the depression in 1931 and afterwards,

which forced the management to further economies. The outcome was a strike, and a promise by the management that no labour extension research would take place for two years.

478. SPINNING AND PREPARATION OF WARP YARN FROM OOMRAS COTTON. By S. Taylor. (*Text. Weekly*, xv., **361**, 1935, p. 133.) In order to demonstrate the suitability of a short-stapled Indian cotton of the Oomras type for spinning and manufacturing, an experiment was carried out by the British Cotton Industry Research Association at the request of the Lancashire Indian Cotton Committee. The results showed that under normal mill conditions for coarse counts employed in the experiment it was possible to spin satisfactorily from this Oomras cotton a suitable warp yarn of 12's counts for the specified cloth, and that no serious difficulty was experienced in weaving which could be attributed to the methods used for winding and beaming.

479. STUDIES IN THE SAMPLING OF YARNS FOR THE DETERMINATION OF STRENGTH. PT. II. EXPERIMENTAL SAMPLING AND SIGNIFICANCE OF ESTIMATES OF SINGLE THREAD, LEA, AND BALLISTIC METHODS OF TESTING. By D. F. Kapadia. (*J. Text. Inst.*, xxvi., **1**, 1935, T1.)

[*Cf.* Abstr. **316** of this volume.]

480. WHERE 700 MILLION LBS. OF COTTON GO. (*Text. Weekly*, xv., **373**, 1935, p. 453.) The motor and cycle tyre business absorbs 500 to 700 million lbs. weight per annum of cotton. It is a stupendous development in a branch of trade that did not exist before John Dunlop made the first pneumatic periphery for road travel. The first tyre was made by David Moseley and Sons, Ltd., Ardwick, Manchester. In several other ways the automobile and allied trades use vast quantities of cotton—for brake linings, waterproof goods, radiator hose, etc.

Although tyres are usually regarded as rubber manufactures, cotton is actually the predominant constituent in weight, volume, and value. Cotton has long since proved itself the best resister to the heat required during the vulcanizing process, and with the ever-increasing number of motors and cycles coming on the roads, there is no likelihood of any decline in the 700 million lbs. of cotton consumption, not even with the huge mileages obtainable from modern tyres. Today the cotton industry can supply cotton cord that will last for 100,000 miles, or even more. Cord foundations are the universal vogue, and it is said that speeds have increased 80 to 100 per cent. since the developments in usage of cotton cords compared with the days when the tyre makers insisted on square-woven fabric.

481. COTTON AS A RAW MATERIAL FOR THE RUBBER INDUSTRY. By W. H. Reece. (*Trans. I.R.I.*, **10**, 1934, p. 101. Abstr. from *J. Text. Inst.*, xxvi., **2**, **1934**, A81.) A lecture dealing with the use of cotton in belting and hose manufacture.

482. COTTON FABRICS FOR THE RUBBER INDUSTRY. By F. Chadwick. (*Trans. I.R.I.*, **10**, **1934**, p. 114. Abstr. from *J. Text. Inst.*, xxvi., **2**, 1935, A81.) The physical properties of various growths of cotton are discussed, and the tests applied to raw cotton described. The factors influencing the design of fabric suitable for use in belting, tyre and hose manufacture are considered.

LEGISLATION.

483. AUSTRALIA: *Raw Cotton Bounty Act, No.* 22 *of August* 4, 1934. Provides for the payment of bounty on the production of raw cotton, and for other purposes.

Raw Cotton Bounty Act, 1934. (*Commonwealth of Australia Gazette*, November 1, 1934.) A notification by the Minister of Trade and Customs, dated

October 26, 1934, states that a Cotton Supplies Committee has been established to advise the Minister of Trade and Customs on matters concerned with the administration of the Raw Cotton Bounty Act, 1934, and related aspects of the Commonwealth Government's cotton policy.

Raw Cotton Bounty Act, 1934. (*Commonwealth of Australia Gazette*, January 24, 1935.) A Proclamation of the Governor-General of the Commonwealth of Australia, dated January 23, 1935, and cited as Customs Proclamation No. 285, fixes the first day of February, 1935, as the date on which the said Act shall come into force.

Statutory Rules, 1935, *No.* 12, dated February 20, 1935, give the regulations governing claims for bounty on raw cotton.

484. NYASALAND: *Cotton Ordinance*, 1934 (No. 16 of 1934, dated October 24, 1934). An ordinance to secure and maintain the production of the highest quality of cotton, and in general to regulate and control the cotton industry.

TRADE, CO-OPERATION, ETC.

485. THE WORLD'S COTTON POSITION—III. By J. A. Todd. (*Trop. Agriculture*, xii., **4**, 1935, p. 104.) Changes that have occurred in the situation since the second article was written are brought up to date, and the effects of recent developments on the Empire cottons are discussed.

[*Cf.* Abstr. **330** of this volume.]

486. A REVIEW OF THE WORLD TEXTILE INDUSTRY. By A. Niemeyer. (*Text. Rec.*, lii., **623**, 1935, p. 63.) Deals with the position in Great Britain, the European gold block countries (France, Italy, Switzerland, Holland, Belgium, Poland) and Japan.

487. PIONEERS OF THE MODERN AGE: LANCASHIRE'S CONTRIBUTION TO INDUSTRY. By W. H. Brindley. (*Times Trade and Eng.*, March, 1935, p. xxxviii.) Brief accounts of the inventions of John Kay, Richard Arkwright, Osborne Reynolds, and Ferranti.

488. TENDENCIES IN LANCASHIRE: NEW ERA IN SIGHT. By J. Bennett Storey. (*Times Trade and Eng.*, March, 1935, p. v.) The two problems before the county are the adjustment of the cotton industry in face of increased competition, and the necessity of further development of other industries, though these latter are much larger than is usually supposed—only some 56 per cent. of workers being employed by cotton, coal-mining and engineering.

489. THE LANCASHIRE COTTON INDUSTRY. By W. H. Catterall. (*Times Trade and Eng.*, March, 1935, p. xxiv.) Deals with the national economic importance of the industry.

490. RAW COTTON: BUYING AND SELLING. By H. C. Barnes. (*Times Trade and Eng.*, March, 1935, p. xxiii.) A simple and clear account of the services rendered to the cotton industry by the Liverpool and Manchester raw cotton markets. The author pays tribute to the valuable assistance afforded by the British Cotton Growing Association, which was formed to encourage cotton growing in British countries, and also by the Empire Cotton Growing Corporation, which since the War has been responsible for finding suitable cotton-growing areas, the best kinds of cotton, and pest control. The work is described as having been of enormous value to Lancashire and not less so to British countries overseas, in that it has inspired Egypt and India to establish their own organizations for similar efforts. The value of the work carried out by the British Cotton Industry Research Association is also stressed.

491. **Forecasting Raw Cotton Prices.** By W. H. Slater. (*Text. Weekly*, xv., Nos. 359 and 363, 1935.) The fifth paper of this series is headed "Theory Compared with Fact," and indicates where Method "A" can go wrong. The sixth article deals with Method "B," an analysis of the current cotton situation from week to week.

[*Cf.* Abstr. **171** and **328** of this volume.]

492. **International Congress for Scientific Management.** We have received from the Federation of British Industries a notice of the Sixth International Congress for Scientific Management, to be held in London from July 15 to 20, under the patronage of H.R.H. The Prince of Wales. Management has never previously been the subject of a large conference in this country, and special attention is drawn to it. Programmes and membership forms can be obtained from the Secretary of the Congress at 21, Tothill Street, S.W. 1.

MISCELLANEOUS.

493. **Report on Tests in Australia of Second 15-Ton Motor Transport Unit.** (Issued by the Oversea Mechanical Transport Directing Committee, King's Bldgs., Dean Stanley Street, S.W. 1, 1935.) Motor transport units of this type, consisting of an eight-wheeled tractor fitted with a 130 h.p. Diesel engine, carrying 3 tons, and two eight-wheeled trailers carrying 6 tons each, should go far towards rendering it unnecessary to build any further railways in undeveloped areas until sufficient freight has been worked up by this means to ensure that a new railway would pay its way from the day on which it was opened. By spreading the load over three vehicles, having in all 12 axles, it is possible to restrict the maximum laden axle load to 2¾ tons, thus reducing road wear to a minimum.

The second unit produced by the Committee has recently completed a test, conducted under commercial running conditions, of over 9,000 miles in the centre of Australia, using Alice Springs in the Northern Territory as a base, over roads that in the majority of cases were mere tracks. The surfaces varied from deep sand and plains covered with loose stone, to heavy sandy creek crossings, black soil, and deep mud after rains, and the temperature was at times tropical. The unit, however, continued at work hauling its paying load of 15 tons at times when only the lightest motor vehicles of the ordinary type could keep the road. Only two mechanical breakdowns were experienced, despite the severity of the test, both occurring to standard parts, and neither of serious importance. The fuel consumption averaged 3·15 miles per gallon of Diesel oil, and the speed 12·87 miles per hour over the entire distance. These figures were most satisfactory considering the 81,933 ton-miles involved and the cross-country conditions of operation. It was found possible to cover up to 170 miles a day at an average speed of 17·45 miles per hour when lightly loaded on return journeys. On some of these journeys the fuel consumption averaged 4·5 miles per gallon. The cost per net ton-mile at which the unit worked during the 29 weeks' tests was 3·70d., which is far lower than that attained by any other motor vehicle working under average oversea conditions after providing adequately for overhead charges. The trials are considered to have been a great success, and the satisfaction of the Australian Government in the performance was expressed by their purchase of the unit.

The Committee have prepared the preliminary design for a unit, built on similar lines, to carry a useful load of 30 tons, with a laden axle load of 4½ tons, and hope that the necessary finance will be made available to enable such a unit to be built and tested.

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the date of writing the followng officers are on leave, or will shortly be arriving in England from cotton-growing countries:

British Guiana	Mr. L. D. Cleare.
Ceylon	Mr. R. R. Follett.
,, ...	Mr. A. W. R. Joachim.
Fiji	Mr. B. L. Field.
,, ...	Mr. C. R. Turbet.
Gold Coast	Mr. W. H. Beckett.
,, ,, ...	Mr. W. F. Gwilliam.
,, ,, ...	Mr. C. W. J. Line.
,, ,, ...	Mr. T. Lloyd Willis.
,, ,, ...	Mr. F. A. Robb.
,, ,, ...	Mr. J. M. Ward.
,, ,, ...	Mr. J. M. Wingate.
India	Dr. W. Burns.
,, ...	Mr. J. B. Hutchinson.
,, ...	Mr. W. J. Jenkins.
,, ...	Mr. P. B. Richards.
,, ...	Prof. W. Roberts.
Kenya Colony	Mr. V. A. Bickley.
,, ,, ...	Mr. S. Gillett.
,, ,, ...	Mr. A. J. Kemp.
,, ,, ...	Mr. T. Y. Watson.
,, ,, ...	Mr. H. Wolfe.
Nigeria	Mr. H. C. Doyne.
,, ...	Mr. O. T. Faulkner.
,, ...	Mr. A. V. Gibberd.
,, ...	Mr. J. L. B. Kincaid.
,, ...	Mr. J. K. Mayo.
,, ...	Mr. E. H. G. Smith.
,, ...	Mr. R. Turner.

Nyasaland	Mr. A. G. Beattie.
,, ...	Mr. J. D. Brown.
,, ...	Mr. C. Smee.
,, ...	Mr. A. E. Trotman.
Northern Rhodesia	Mr. W. Allan.
,, ,, ...	Mr. I. W. M. A. Black.
Sierra Leone	Mr. R. R. Glanville.
Sudan	Mr. M. A. Bailey.
,, ...	Mr. H. E. King.
Tanganyika Territory	Mr. B. J. Hartley.
,, ,, ...	Mr. T. S. Jervis.
,, ,, ...	Mr. R. D. Linton.
,, ,, ...	Mr. G. Milne.
,, ,, ...	Mr. J. Robertson.
Uganda	Mr. G. W. Nye.
,, ...	Mr. A. L. Stephens.
West Indies	Mr. F. McG. Bain.
,, ,, ...	Mr. W. E. Bassett.
,, ,, ...	Mr. F. Stell.
,, ,, ...	Mr. R. O. Williams.

Sir Geoffrey Evans, Principal of the Imperial College of Tropical Agriculture, Trinidad, and Controller of the Corporation's Research Station in that island, is on leave in this country.

The following officers of the Corporation's staff abroad are on leave, or will shortly be arriving in England:

Fiji	Mr. R. R. Anson.
Nigeria	Mr. G. Browne.
Northern Rhodesia	Mr. A. G. Bebbington.
South Africa	Mr. D. MacDonald.
,, ,, ...	Mr. E. O. Pearson.
Swaziland	Mr. H. Hutchinson.
Sudan	Dr. H. Greene.
,, ...	Mr. R. L. Knight.
West Indies	Dr. S. C. Harland.
,, ,, ...	Dr. T. G. Mason.
,, ,, ...	Mr. R. A. Silow.

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THE EMPIRE COTTON GROWING REVIEW

VOL. XII. OCTOBER, 1935. NO. 4

THE IMPERIAL INSTITUTE

BY

SIR HARRY LINDSAY, K.C.I.E., C.B.E.,
Director, Imperial Institute.

I.—TECHNICAL WORK: INTELLIGENCE AND INVESTIGATIONS.

THE principal objects of the Institute on its technical side are briefly: to act as a clearing-house for the collection and dissemination of information relating to the sources, production, uses and marketing of raw materials; to conduct preliminary investigations of Empire raw materials with a view to determining their value in industry, and to advise on the production of materials for which a remunerative market can be found.

This work is carried out by two Departments, the Plant and Animal Products Department and the Mineral Resources Department, each of which includes an Intelligence and Investigations Section and has an Advisory Council and Technical Committees associated with it. The following summary of activities refers to the work of the Plant and Animal Products Department as being the Department more directly concerned with cotton cultivation and allied agricultural questions, but the Mineral Resources Department is organized on the same lines and carries out similar work in its own sphere.

The Advisory Council of the Plant and Animal Products Department consists of official representatives of the Dominions, Colonies and India and of leading scientific, technical and commercial authorities. Its functions are to advise on all matters relating to the utilization of plant and animal products and to initiate schemes of work which might be undertaken by the Institute. In order to facilitate its work the Council has appointed a number of representative Advisory Technical Committees, each of which deals with a

special subject—*e.g.*, Vegetable Fibres, Oils and Oilseeds, Essential Oils and Resins, Hides and Skins, Timbers, etc. Each of these Committees includes scientific and technical authorities, as well as representatives of the trades and industries concerned in its particular group of products, and in every case the Chairman is a member of the Advisory Council.

The association of the Advisory Council and Technical Committees with the Investigations and Intelligence sections of the Department constitutes an efficient organization for dealing authoritatively with all questions connected with the development of Empire raw materials of plant and animal origin. Many important problems have been jointly investigated and a number of valuable Reports have been issued, including Empire Fibres for Marine Cordage; Empire-grown Sisal and its importance to the cordage manufacturer; Indian (Sann or Sunn) Hemp, its production and utilization; Production of Tung Oil in the Empire; the Collection of Reptile Skins for commercial purposes, with reference to the possibilities in Empire countries; the Drying of East African Hides, with reference to the prevention of blister; Grading Rules and Standard Sizes for Empire Hardwoods intended for shipment to the United Kingdom.

INTELLIGENCE.

The work of the Intelligence Section relates chiefly to the collection and dissemination of information of a technical and commercial character regarding the sources, production, uses and marketing of raw materials; and the answering of enquiries received on these subjects from all parts of the Empire.

In order to deal efficiently with this branch of the work it is essential that the fullest information should be available regarding developments in the production and utilization of raw materials not only in the British Empire but also in foreign countries. This is ensured by the systematic indexing of the literature on the subject, including Reports and other publications of Government Departments, periodicals and trade journals, both British and foreign. The index has been in existence for over thirty years, and some idea of the work involved in its maintenance is indicated by the fact that the number of serial publications regularly looked through in the Plant and Animal Products Department is now 1,130.

The principal medium for the dissemination of information relating to raw materials of plant and animal origin is the quarterly *Bulletin of the Imperial Institute*. This publication constitutes a record of progress relating to agricultural, mineral and other

industries, with special reference to the utilization of the raw materials of the Dominions, Colonies and India. Each number includes records of the principal investigations conducted at the Institute, special articles and notes, a summary of the results of current research conducted by Government Technical Departments overseas, a classified bibliography of publications received in the Institute's library during the preceding quarter, and notices of recent literature.

Requests for information on raw materials and their utilization reach the Institute from practically every country of the Empire, from Government Departments, firms and individuals. They relate to a wide diversity of products, and their nature and scope can best be illustrated by a few examples representative of different classes of enquiry.

(1) *The Commercial Position of Overseas Empire Products and the Prospects of Marketing Supplies in the United Kingdom.*

Recent enquiries under this head have included the possibility of exporting passion fruit juice from Southern Rhodesia; the utilization of unmarketable surplus cattle in East Africa for the manufacture of animal by-products, and the prospects of marketing the latter; the suitability of British Honduras chicle for the manufacture of chewing-gum in comparison with the Mexican product; the possibility of increasing the overseas market for olive products (oil, soap, etc.) from Palestine; the prospects of marketing a concentrated pyrethrum extract from Kenya; the market for shark skins, shark-liver oil and other products from Australia, South Africa and Seychelles; the marketing of preserved ginger from Burma.

(2) *Methods employed in the Cultivation of Crop Plants and in the Collection and Preparation of Products for the Market.*

Such enquiries have included the possible production in Empire countries of the special types of tobacco leaf required for the West African market; the cultivation of Perilla seed in the Sudan; the growing of the tree *Rhamnus purshiana* in Kenya for the production of cascara bark; the export of oranges from Sierra Leone, and the methods adopted in citrus-growing countries for colouring the fruits; the cultivation of stramonium leaves in Rhodesia; the preparation of raisins and sultanas in Kenya; the characters of the corosos palm, and the uses of the nuts as vegetable ivory, in connection with the possible cultivation of the palm in Malaya.

(3) *Particulars of Machinery or Factory Plant required in the Preparation of Plantation and other Products for the Market.*

In these cases manufacturers are consulted and estimates for the necessary equipment obtained. Recent enquiries of this group have related to the preparation of coir and coir yarns in Kenya and Seychelles; the production of split peas in Canada and the West Indies; modern plant for the manufacture of ghee in Nigeria and machinery for making cans for packing it; equipment for the production of grape fruit juice in Dominica from culled fruits; the preparation of essential oils in East Africa and elsewhere, with particulars of stills suitable for the purpose; machinery for making dried egg products.

Investigations.

The Investigations Section is equipped with laboratories specially adapted for the chemical and technical examination of raw materials, with a view to determining their composition and value and the possibility of their industrial utilization.

The requests for investigations come from all parts of the Empire, particularly from the Colonies, and are mainly received from Departments of Agriculture and Forestry. The samples forwarded for examination include products from wild plants indigenous to the country; products which are being grown experimentally with a view to the subsequent introduction of the crop on a commercial scale; and products resulting from experiments carried out with a view to the improvement in the quality and value of crops already cultivated.

The samples comprise many different classes of materials, such as fibres and paper-making materials; oils and oilseeds; essential oils and materials yielding them; gums and resins; foodstuffs and fodders, including teas, coffees, peas and beans, starches, etc.; tobacco; tanning materials; drugs and insecticides; and many other miscellaneous products.

The large majority of the investigations are carried out in response to definite requests for information regarding the material in question —*e.g.*, its composition and quality in comparison with the same material from other sources; the purposes for which a new or little-known material could be used; or whether new uses can be found for an already known material. In order to answer these questions laboratory investigations, sometimes including small-scale technical

trials, are necessary in the first place, and in the light of the results obtained manufacturers and merchants can be consulted as to the commercial possibilities. In suitable cases arrangements can be made for a trial on a manufacturing scale.

The following summary of the investigations carried out during 1934 will illustrate the varied character and sources of the samples submitted:

The fibres included: Sunn hemp from India and Uganda; *Agave amaniensis* fibre from Tanganyika; sisal from India; hibiscus fibre from the Sudan; coir from Seychelles; Hedychium fibre from British Guiana; ramie from Uganda; kapok from New Guinea, and Bombax floss from Kenya. Among the paper-making materials investigated were samples of *Pinus* and *Cupressus* woods from South Africa and Southern Rhodesia, and of *Typha latifolia* reeds from Australia.

The oils and oilseeds examined during the year included: Tung nuts and oil from Burma, Cyprus, Nyasaland and Australia; *Aleurites montana* nuts from Burma, Ceylon and Hong-Kong; ground-nuts and ground-nut oil from St. Vincent, Kenya and the Sudan; mustard seed from Tanganyika; castor seed and oil from St. Vincent and Nyasaland; coconut kernels from Seychelles; candle-nuts and Ximenia nuts from South Africa; olive-oil soap from Palestine.

Much interest is being taken at the present time in various parts of the Empire in the production of essential oils, and the numerous samples submitted for examination included: Geranium oils from South Africa, Northern Rhodesia, Kenya and Ceylon; lemongrass oils from Kenya, Uganda and Seychelles; Cymbopogon, Zanthoxylum and peppermint oils from Kenya; Æolanthus oil from Northern Rhodesia; citronella, palmarosa and cinnamon root bark oils from Seychelles; Ocimum oils from Seychelles and the Sudan; lime oil from Trinidad; and pimento leaf oil from Jamaica.

The foodstuffs and fodders examined included: beans from St. Helena and Nigeria; peas from Tanganyika; canna and banana flours from Ceylon; zamia starch from British Honduras; cassava products from India and the Sudan; ginger from Nigeria, Uganda and Ceylon; and series of feeding-stuffs from South Africa and Sarawak.

Among the drugs and insecticides investigated were: aloes from the Sudan; papain from Palestine; Mundulea roots from South Africa; Dolichos tubers and solanaceous plants from Kenya; Psyllium seeds from Cyprus; Derris roots from Seychelles; and Artemisia plants from Kenya and the United Kingdom.

II.—WORK OF THE IMPERIAL INSTITUTE IN RELATION TO COTTON CULTIVATION IN THE EMPIRE.

The development and progress of cotton cultivation in countries of the British Empire are now being ably supported and encouraged by the Empire Cotton Growing Corporation, but at the beginning of the present century the Empire produced very little cotton suitable for the needs of Lancashire, the Indian staple being too short and coarse for spinning by the machinery then in general use.

The danger to which the British cotton industry was exposed by its dependence on the United States led manufacturers to consider the possibility of obtaining supplies from other sources, and in 1901 at the annual dinner of the Oldham Chamber of Commerce an important discussion took place on the necessity of securing increased supplies for Lancashire spinners. At a subsequent meeting a special Committee was appointed, which at once proceeded to make enquiries into the possibilities of cotton-growing in nearly every part of the British Empire. As an outcome of these negotiations the British Cotton Growing Association was inaugurated in June, 1902. The movement received the support of H.M. King Edward VII., who, in his speech from the Throne on February 2, 1904, said: "The insufficiency of the supply of the raw material upon which the great Cotton Industry of this country depends has inspired me with deep concern. I trust that the efforts which are being made in various parts of My Empire to increase the area under cultivation may be attended by a large measure of success."

From this time forward a large amount of work on cotton was carried out at the Imperial Institute with the aid of a special grant of £2,000 from the Treasury, to be spread over four years from April 1, 1905, and a special assistant (Mr. F. W. Barwick, now Director of the Manchester Chamber of Commerce Testing House and Laboratory) with a thorough knowledge of textile research was added to the staff.

Work accomplished by the Imperial Institute from that time forward included not only the examination of the quality and defects of specimens of cotton submitted by practically all the Governments of the tropical Colonies and Protectorates as well as by spinners, and the preparation of reports and recommendations on these specimens, but in addition the conduct of special investigations connected with such collateral subjects as the best method of disinfecting cotton seed, the identification and treatment of insect and fungus

pests which attack the cotton plant, and the analysis of soils on which it was proposed to plant cotton. Much advice as to the selection of seed, methods of planting, manuring, etc., was given to enquirers. The whole of the publications, British and foreign, relating to cotton and its cultivation were systematically collected and collated for reference, and touch was maintained with foreign and Colonial Governments engaged in cotton-growing, and especially with the work which was in progress in the French and German African possessions. From time to time information likely to be of importance to British cotton-growers was printed in the form of special articles in the *Bulletin of the Imperial Institute*.

Abstracts of the principal reports made by the Imperial Institute during the years 1904-7 were published in the Colonial Office Miscellaneous Series under the title of "British Cotton Cultivation: Reports on the Quality of Cotton Grown in British Possessions."

In 1905 it was decided to hold an exhibition at the Imperial Institute, primarily with the object of illustrating and drawing attention to the position of cotton-growing in British possessions. The staff of the Imperial Institute, with the co-operation of the British Cotton Growing Association, was responsible for the arrangement and description of the exhibits, which included samples of cotton grown in British possessions shown in such a manner as to indicate their special characteristics and also to illustrate the various stages of cotton manufacture and the principal machinery employed. In addition to explanatory labels, diagrams and photographs were employed to depict the different processes of preparation.

The exhibition was attended at its opening by H.R.H. the Prince of Wales (now H.M. King George V.) and attracted numerous visitors, among whom were manufacturers and many persons engaged in cotton-planting overseas. The exhibition was also visited by the International Federation of Master Cotton Spinners' and Manufacturers' Associations, which was then in session in London. Many of the foreign representatives of the Federation expressed great interest in the exhibition and were supplied with particulars of the methods of examination adopted at the Institute. In return much valuable information was obtained regarding the quality and character of cotton produced in foreign countries and also as to the methods of cultivation followed. A Handbook to the exhibition was issued which included much information concerning the cultivation of cotton and the industrial uses of the different varieties. Owing to the interest created by the exhibition, a representative collection of British-grown cottons and of samples illustrating the processes of

manufacture was maintained for many years in the Public Exhibition Galleries of the Institute. Numerous applications have been received for specimens of cotton for educational and commercial purposes, and these have been supplied.

The work of the early years was continued by the Imperial Institute until 1914, when naturally some interruption was caused by the outbreak of war. Subsequent to the war the assistance of the Institute was less in demand owing to the formation of the British Cotton Industry Research Association in 1919 and the establishment in 1921 of the Empire Cotton Growing Corporation.

In recent years, however, the Imperial Institute has assisted the operations of the Corporation in various ways, especially in connection with the experimental work carried out at the Corporation's Plant Breeding Station at Barberton, Transvaal, on rotation crops for cotton. In the course of these experiments numerous samples of foodstuffs, including soya beans, tepary beans, *Lathyrus sativus* seeds, maize, and sunflower heads and seeds, have been submitted to the Institute for analysis, and reports on their quality and commercial value have been furnished to the Corporation.

In addition the Institute has recently analyzed a large number of samples representing different parts of sunflower, maize, cotton, tepary bean and soya bean plants, also produced in rotation crop experiments, in connection with an investigation in progress at Barberton to ascertain the amounts of various soil nutrients removed by each crop.

Reference has been made above to the assistance rendered by the Imperial Institute in the early stages of cotton cultivation in the Empire by carrying out analyses of soils on which it was proposed to grow cotton. The examination of tropical soils still occupies an important place among the many activities of the Institute. Auxiliary to this is the determination of the suitability for local use, or for export, of fertilizing materials, such as guanos, phosphates, plant ashes, etc., which are frequently forwarded for examination.

This branch of the work of the Institute has been carried on for many years, and much valuable information and knowledge concerning the composition, potential value, and deficiencies of many tropical soils has been accumulated. Increasing importance is being attached to systematic soil surveys, and the Imperial Institute has been able to assist in the examination of many of the survey samples collected in various Colonies.

This work, on account of the nature of the analyses and tests involved, is carried out in laboratories of the Mineral Resources

Department of the Institute. Soils are not usually regarded as mineral resources, but they are complex products of the decomposition and weathering of many minerals and rocks, and mineralogical examinations, as well as chemical analyses, often give valuable information regarding their origin and composition.

The soils examined at the Institute may be roughly divided into three groups: (1) those sent for analysis in order to determine their fertility for crops in general, (2) those sent in order to determine their suitability for the cultivation of particular crops, and (3) those sent in order that the specific reason for the failure of, or for defects in, a particular crop might, if possible, be ascertained.

The chemical and mechanical analysis of a soil does not always solve the problem confronting the agriculturist, but very useful information is often obtained. For example, a number of soils recently examined at the Institute, and suspected by the sender to be deficient in some essential constituent, were found to be quite unsuitable in their physical condition for the growth of the crop which was being cultivated. In another case, certain soils on which rosette disease of ground nuts occurred were examined in order to ascertain whether the composition of the soil had any bearing on the incidence of the disease, and though no definite conclusions could be drawn, a possible contributory factor was suggested. Again, a number of soils are now being examined in order to determine whether any relation exists between their chemical composition and the quality of the deep-rooting crops which they bear, and it has been found that the subsoils, where the crops are poor, suffer from a deficiency of phosphate.

With regard to the direct help in this way which the Institute has been able to afford the cotton grower, the cotton soils which have been examined fall mainly into Group 2, mentioned above, though a large number of those in Group 1 are also potential cotton-growing soils. To give a few specific instances, soils from Nyasaland, Uganda, Nigeria, etc., have been examined in order to determine their suitability for the cultivation of this crop, and suggestions have been made regarding the necessary fertilizers which should be applied, in those cases where analyses showed that there were deficiencies in essential plant-food constituents.

Since 1929 the Imperial Institute, in its soil investigations, has worked in close co-operation with the Imperial Bureau of Soil Science, and the confirmation and advice of their experts is always sought in cases where recommendations regarding the manurial treatment of soils are made.

Received July, 1935.

THE USES OF COTTON SEED

BY

JOHN A. TODD, M.A., B.L.

MUCH has been written in recent years about the close connection between the price of cotton and the tendency of the growers throughout the world, especially in America, to reduce or increase the area under cotton according to the actual cash return they receive for the crop. In such calculations, however, it must be remembered that the price received for the cotton seed is also a factor in the economic yield of the crop, and sometimes a more important factor than is generally realized. In America a waggon load of 1,500 lb. of seed cotton produces approximately a 500-lb. bale of cotton lint and 1,000 lb. of cotton seed, but it will be seen from the following table that the proportions of the total cash return to the planter which come from the lint and the seed respectively have, to take only recent years, varied very greatly.

TABLE I.—ESTIMATED PRICES RECEIVED BY GROWERS FOR COTTON LINT AND SEED.

	Prices.		*Total Prices Received.**			
	Cotton (*Cents per Lb.*).	*Seed* (*$ per Ton*).	*Cotton* ($).	*Seed* ($).	*Total* ($).	*Seed per Cent. of Total.*
May 15, 1930 ..	14·5	30·61	29·00	6·12	35·12	17·4
,, 1931 ..	8·8	22·32	17·60	4·46	22·06	20·2
,, 1932 ..	5·2	9·66	10·40	1·93	12·33	15·7
,, 1933 ..	8·2	12·00	16·40	2·40	18·80	12·8
,, 1934 ..	11·0	22·23	22·00	4·45	26·45	16·8
,, 1935 ..	12·0	39·36	24·00	7·87	31·87	24·7

Thus in the 1934-35 season the drought in America produced a great shortage, not only in the cotton crop, but also in the supply of hogs (depending on the corn crop, which suffered even worse than cotton) and therefore of lard, as well as in other vegetable oil seeds, with the result that the price of cotton seed shot up to levels that have not been seen for many years.

* Based on a yield of 200 lb. of lint per acre and 400 lb. of seed.

The reason why the prices of cotton and cotton seed move almost entirely independently of each other lies in the fact that the uses of cotton seed bring it into a world market in which cotton seed plays a relatively small part, and its price is therefore affected largely by the supply of all the other commodities which enter into that market. It should therefore be of interest to cotton growers to have some idea of what these other commodities are and how they compete with cotton seed.

The development of the cottonseed trade, with the extraordinary variety of uses to which it is now put, is one of the romances of modern industry. At first the seed was regarded in many countries almost as a nuisance which cost money to get rid of, unless it could be used as manure or sometimes as fuel. Before the War it had become one of the stock illustrations of the utilization of by-products; now it is an industry in itself, with a turnover worth probably £50,000,000* per annum, and its products are the raw material of a hundred trades, from cattle-rearing to soap-making, edible oils and artificial silk.

The general outline of the processes of manufacture must first be described. Its nature depends in the first place on the character of the seed. American Upland seed and other similar varieties are what are known as "white" or "fuzzy," owing to the short lint or fuzz with which the whole seed is coated, and which is not removed by the process of ginning. Egyptian and Sea Island seeds, on the other hand, are "black" or "clean" seeds, having no short lint or fuzz except occasionally a small tuft of short green lint on the pointed end of the seed. In America, therefore, it has always been customary to put the seed through what practically amounts to a second ginning process called "delinting," and the short lint thus obtained is what is known as "linters." These used to be regarded as of comparatively small commercial value, being fit only for such purposes as gun-cotton or blotting-paper, or for mixing with waste cotton in spinning low-count yarns; but they constitute quite a considerable proportion of the American crop—say, 1,000,000 bales—and it is a curious fact that the amount of the linters crop does not vary in proportion to the lint crop. On the average of the last ten years, however, the linters crop was about 7½ per cent. of the whole crop. A similar process has for many years been applied to Indian

* The world's cotton crops now amount to about 25 million bales of 500 lb. Every bale of cotton lint represents roughly 1,000 lb. of seed, so that the total cottonseed crop must be about 12 million tons, with an average value of, say, £4 per ton. The value of the finished products is of course much larger.

cotton seed or Bombay seed, as it is generally called in European markets, as well as to Chinese, Russian, Brazilian and African cotton seed. Even after delinting, however, the greater part of the short fuzz still remains on the seed. Since the War an important new use for linters has been as the raw material of artificial silk, though this use has not yet been fully developed in England owing to the high cost of securing the necessary cleanliness or cellulose purity of the product. The best linters are now worth rather more than half the price of American Middling cotton, but lower grades go to much smaller prices.

The next process in the case of American seed is decortication, which consists practically of cutting or cracking the seed so as to separate the kernel from the husk, with the fuzz which still adheres to it. In Egypt and in Europe (except where seeds of the American type are handled) the whole seed is crushed without separating husk and kernel, and Bombay seed is treated in the same way as Egyptian. In China, where cottonseed crushing began only about 1910, the American methods are followed, and the same applies generally to the Russian crop, most of which is now of the American type of seed.

The meal or crushed kernel, or the whole seed crushed, as the case may be, is then heated by steam in an enormous kettle, after which it is put into bags or wrapped in cloths in an oblong shape; it is then pressed in hydraulic presses of great power, thus extracting the oil and at the same time giving to the remainder the peculiar form in which it is so well known as cake for cattle-feeding purposes. There is now an alternative method, known as the Expeller process, of extracting the oil from the crushed seed by forcing it through a tapered cylinder by the action of a heavy rotating screw. In this machine the residue or cake is thrown out in a broken condition, and is known as Expeller cake.

The crude oil from the presses is refined by various processes, chiefly based on the use of caustic soda, and is used either as edible oil or for soap-making, according to its quality. In the case of Egyptian oils made from undecorticated seed, a small quantity of dark resinous matter exudes from the husk in the crushing process, which darkens the colour of the oil and gives it a peculiar flavour. To remedy this it is necessary to use stronger chemicals in refining the oil, but until the discovery of the deodorization process about 1910 it was never possible to eliminate the peculiar flavour entirely, and this seriously handicapped the use of these oils for edible purposes.

The black grease or refuse of the oil-refining process goes through

various further processes, by which still other by-products, such as glycerine and white candle grease, are taken from it. The residue is at last reduced to the consistency of pitch, and in this form it is spread upon brown paper with a thin layer of coarse cotton fibre on its surface, thus forming the familiar waterproofed wrapping paper in which many forms of textile and other goods are packed, especially for export. This pitch is now also used for insulating covered electric wires. There is also another refining process by which a cheap form of soap (useful for textile purposes) is produced directly.

In view of the predominance of the American crop in the world's cotton supply, American cotton seed still supplies the bulk of the cottonseed oil trade. It is chiefly manufactured in the United States, and is largely consumed in that country, as well as being exported to all parts of the world in normal seasons. A considerable quantity of cottonseed meal is also exported, but the cake is mostly consumed in the United States. The Egyptian crop is partly crushed in Egypt, though the greater proportion of it is exported in the form of seed to European ports. Some of the Bombay crop is also exported, chiefly to the United Kingdom. France and Germany used to take a considerable share of the Egyptian crop, but since the War England has taken the lion's share, and since 1931 the Continent's share has been very small.

The English cottonseed industry is centred in Hull, Liverpool and London, with a considerable trade also in Glasgow, Leith and Bristol. It used to be confined practically to Egyptian and Bombay seed, Egyptian being more than half of the total, but in recent years increasing quantities of Empire seed from East and West Africa and also of Brazilian white seed have been coming to the United Kingdom. Egyptian black seed, however, still forms the bulk of the U.K. trade. The finished products must, of course, face the competition of those of the American industry.

In discussing the relative value of different oil seeds it is necessary to keep in view the two main products of the seed—namely, oil and cake. Thus, as regards the quality of the oil produced, the American method was superior for the production of high-class oils; the removal of the husk or shell by decortication and the use of the crushed kernels alone for the production of oil produced a finer quality of oil than could be obtained by crushing the whole seed. Accordingly, the standard grade of American sweet oil, known as "Prime Summer Yellow," used to represent the highest quality among the world's cottonseed oils, while the Egyptian came next and Bombay last.

The application of the American method of decortication to other varieties of white seed in England has, however, produced oils quite equal to the American.

The market for cottonseed oil is highly complex or composite, alike from the side of supply and of demand. Cottonseed oil enters into two formerly distinct markets which may be generalized as edible oils and soap fats, and in each of these fields it had competitors innumerable. Thus, as edible oil, it had to find its place in a long list containing all the animal fats, lard, and even butter itself, as well as all the other edible vegetable oils, especially olive oil. In this branch of the market American cottonseed oil, until before the War, stood almost alone. Egyptian oil, owing to the peculiar flavour above referred to, was so far behind the American as to be hardly a competitor at all, while Bombay cottonseed oil was not regarded as possible for edible purposes. Bombay oil, along with a number of other vegetable oils such as those obtained from linseed, maize, soya beans, rubber seed, copra, cocoanut, palm oil, sunflower and many others, the very names of which are hardly known to the average layman, had their places at various points in the supply of vegetable oils; they were mainly used in the soap and candle trades and other manufactures, where also until then Egyptian cottonseed oil found its chief demand. In this trade the vegetable oils had to compete with tallow, whale oil, and other low-grade animal fats, the better qualities of which came into the more profitable market for edible products. Linseed oil had, of course, its own special market for paint mixing, and in this it had practically no competitor, though latterly soya bean oil had been tried for this purpose with some success. Mineral oils such as petroleum are, of course, an entirely separate branch of the oil trade.

Conditions, however, have altered very materially since about 1910 in all trades into which cottonseed oil enters, and the relative position of the different products has been entirely changed. It is impossible to enter into these changes here in detail, but on the whole they have been in the direction of improved methods of dealing with what were formerly the lower-grade oils from the edible point of view, such as Egyptian and Bombay. In 1910, owing to the failure of the usual supply of edible oils and fats, such as olive oil, American cotton seed and American hog lard, a great deal of attention was devoted to discovering improved methods of handling these crops, especially the Egyptian, so as to improve the quality of the product from the edible point of view. It must be remembered that the chief use of oil for culinary purposes in England is not as oil—

butter, the most expensive form of animal fat, has always taken in England the place filled by oil in Europe—but in some composite or made-up form, such as lard, margarine, etc. Until 1910 the makers of these goods preferred either animal fats or the finer American sweet oil. But in 1909 there was an extraordinary combination of disastrous shortages in almost every branch of the supply of edible oils and fats, with the result that the consumers were forced to turn their attention to other sources of supply, and particularly to Egyptian oil. The result was a marked change in the position of cottonseed oil in the English markets. It was no longer merely a soap fat, but also an edible oil (as it had always been in Egypt) and therefore able to command a higher price, which was still further augmented by the general high level of prices of all edible oils. In 1911, however, the enormous American crop entirely reversed the conditions, and the value of Egyptian oil returned to something like its former relative position, while the lower price of American oil again made it available for soap-making.

In the same way, but to a more marked degree, Bombay oil had before the War been looked upon in England as quite impossible for edible purposes, but in modern industry it is not safe to say that anything is impossible, and by about 1910 oil refiners had succeeded in producing quite satisfactory edible oils from Bombay seed.

Many other oils have passed through a similar phase. Thus, copra and palmkernel oil were found adaptable (under pressure of unusual demand) for certain edible purposes, especially margarine, and even soya bean oil, which at first was classed as only fit for soap-making, soon proved a useful substitute for linseed oil, and was then, by still further refining, made into good salad oil.

Again, about 1912 a new process of deodorizing oils produced almost a revolution in the supply both of soap fats and edible oils. This process, first introduced in America, consisted in blowing super-heated steam through the oil, thus removing all objectionable flavours and making it possible to extend enormously the possible sources of supply of edible oil.

Again, a new hardening process was still more of a revolution. The original patent was taken out early in the century, but it was not until about 1911 that it became possible to apply the new method commercially. Broadly, the whole group of oils or fats used to be divided into two sections—soft or liquid oils, and hard or solid oils. Linseed, cotton, rape, whale oil, etc., belonged to the first group; cocoanut and palm oil, etc., to the second group. There was formerly a difference of nearly £10 per ton between the soft oils and the hard

oils in favour of the latter, owing to the fact that a certain proportion of hard oil had to be used in the manufacture of margarine and soap in order to produce a firm product. The new invention was based on the discovery that by the removal of certain constituents soft oils could be converted into a hard stearine. Thus, linseed oil, whale oil and cottonseed oil, when treated by this new process, became harder and more solid than even tallow. The cost of the process is now about £5 per ton. The result was to draw the two groups closer together in value, because of the readiness with which the one could now be substituted for the other. The effect of such a revolution as this was not to increase the available quantity of fats and oils for the world's consumption, but rather to change the course of markets from one industry to another. As far as cottonseed oil is concerned, the result was that the whole output became available for edible purposes in the form of hard fat, but a further supply of that or some other material was needed to meet the requirements of the soap trade.

Another important development in the last ten years is the large increase in the world's production of whale oil, which in one year (1931) reached the enormous total of 3,689,631 barrels (of which six go to a ton) as against about 750,000 barrels before the War. This was, of course, entirely excluded from use as edible oil until the development of the new processes above referred to, but these have completely altered its position. The fact is that the distinctions between edible oils and soap fats and between soft oils and hard fats now hardly exist, and almost any oil or fat can be made available for almost any purpose.

The table on p. 285 summarizes the world's production of the various oils, animal and vegetable, and indicates the relative importance of each source.

A word may be added as to the relative values of other varieties of cotton seed, especially Empire, compared with American. It is difficult to get comparable figures because no quotations are available in England of American cotton seed; but against the recent price of about $40 per ton in America the following quotations of different varieties in this country may be noted: Egyptian (black) about £6 5s. per ton and "White sorts" about £4 to £4 5s. But the real difficulty is in comparing the prices actually received by the growers, for this involves not merely the prices of the different kinds of seed when they reach a world market, but the cost of getting the seed from the grower to that market, and of course, with a commodity like cotton seed, of which the bulk is very great in proportion to its

TABLE II.—WORLD'S PRODUCTION OF VEGETABLE OILS AND FATS.

(FROM MESSRS. FRANK FEHR AND COMPANY'S ANNUAL REVIEW.)

	1929.	1930.	1931.	1932.	1933.	1934.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Olive oil ..	1,007,000	500,000	739,000	810,000	751,000	813,000
Cocoanut oil ..	925,561	827,749	757,744	696,035	793,650	805,169
Cottonseed oil ..	802,466	767,320	775,242	822,643	767,638	748,257
Groundnut oil ..	698,802	697,888	708,339	480,134	576,860	601,004
Linseed oil ..	686,719	570,805	629,885	628,083	533,793	492,271
Soya oil.. ..	365,924	320,519	327,556	370,131	344,252	350,888
Sunflower oil ..	250,957	301,419	303,228	255,400	279,962	230,117
Palm oil ..	230,933	273,746	252,204	272,290	330,949	348,000
Palmkernel oil	211,638	211,229	190,645	228,296	185,682	203,560
Castor oil ..	65,076	54,320	54,352	45,591	51,206	47,407
Wood oil ..	63,000	70,000	50,000	47,220	72,611	65,000
Rapeseed oil ..	52,395	34,872	31,923	49,265	34,287	22,445
Sesame oil ..	40,188	46,800	27,224	21,020	21,976	16,517
Margarine* ..	1,312,500	1,148,000	1,087,658	1,010,567	910,138	893,366
Butter	1,291,887	1,315,000	1,761,000	1,518,950	1,615,062	1,583,300
Lard	799,730	689,805	693,758	702,437	792,230	681,875
Tallow	290,965	284,452	321,629	315,284	362,011	332,032
	7,783,241	6,965,924	7,668,729	7,262,779	7,513,169	7,340,842
Whale oil ..	310,312	466,755	615,700	149,458	425,067	413,058

* Not included in total as it is the product of other oils.

value, this cost is extremely high. In Uganda, for example, cotton seed was almost unsaleable in 1933-34 because the cost of the long railway haul to the port and thence by sea to England was almost more than the very low price which such seed was fetching in England at that time. In 1934-35, however, owing to the scarcity above referred to and the better prices obtainable for all classes of seed, the growers were able to secure a price of about 25s. per ton. That, of course, compares very badly with the $40 paid to the grower in America, but the difference is largely due to the fact that in the American Cotton Belt the market for the seed is at the growers' very door, for seed-crushing plants are scattered all over the Belt. The difficulties of setting up similar plants in the comparatively small areas of the Empire cotton fields are almost insuperable.

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GIZA

BY

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ANY reader of the Review who may be so fortunate as to come sight-seeing to Cairo for the first time, and who nevertheless can find time and interest to examine the cotton work of the Egyptian Government, will be less likely to waste taxi-mileage if he disregards official titles, Arabic or English, and simply directs himself to find the south-west corner of the Zoological Gardens, from the outside. At that precise spot he will find a gateway into a garden-courtyard (Fig. 2), and a brass plate which vaguely denotes the place as the " Cotton Research Board." This is the entrance to " Giza " of the cotton interests.

Giza itself is half a mile off, a town on the western Nile bank, opposite the south end of Cairo on the other bank. The Pyramids of Giza are five miles further away, on the edge of the desert; there is a good view of them across our farm. The area lying between the river and the railway to Upper Egypt, bounded by Giza town to the south, and by new trans-river suburbs of Cairo to the north, was once the domain of Ismail Pasha's palace of Giza, and is now occupied by various schools and colleges, by gardens and experimental farms. In this area our site occupies seventy acres, the equivalent of nearer two hundred acres in ordinary single-crop countries. These seventy acres lie immediately behind the Zoo, and extend to the railway; hence the sailing directions. If the visitor still gets lost, as may happen with Cairo taxis, two wireless masts which stand on the farm itself are his last resort.

Within the limits necessarily imposed by the practical requirements of agricultural administration, a surprisingly large amount of very varied investigation and application is here carried on, and a quiet control over the Egyptian crop is exercised. Few people, even in Egypt itself, are aware of the range of this work and the extent of this control, so that a bird's-eye view of it may be of interest. The technical section of the Ministry of Agriculture which is chiefly concerned with cotton is the Botanical Section, whose annual budget is roughly £20,000. As in the case of other sections also, cotton

represents only a portion of its interests, but in this case nearly the major portion. It is housed at Giza, comprising laboratories, stores, and ginnery, the farm, and also its latest development of an experimental cotton-spinning plant. The latter is the building on the left of the photograph in Fig. 2. The Chemical Section is also at Giza, occupying the further half of the right-hand building. The vestigial survival of the original Cotton Research Board also has offices there, where it functions as a liaison organization between all the technical sections.

At present the Entomological Section has left its spiritual home at Giza, under the pressure of space requirements, and is housed in the Ministry building, some two miles away to the north, where the Agronomic Section is also found; but the problem of designing buildings which will provide sufficient accommodation for everyone on the Giza site, without encroaching on a single metre of the priceless farm land proper, has at last been solved, and Entomology may return to Giza in the future, together with the main Mycological Section. Cotton Mycology has remained at Giza undisturbed, on account of its two acres of specially infected wilt-testing soil.

Some anomalies of nomenclature and administration which often puzzle the visitor can best be understood by summarizing the history of Giza since 1898. This will also make evident the importance we attach to retaining this comparatively small farm in cultivation, in spite of the encroaching demands of builders and of other government administrations, and in spite of the fact that in itself it only meets a fraction of our requirements, which are supplemented in many other localities. In the past seven years I have more than once been instructed to hand over the farm, but it is still there, and with a growing recognition of the value of our "Egyptian Rothamsted," and of a clear area in the middle of town-planning developments, it now seems likely to be preserved for good.

The history of experimental cultivation on the Giza site begins with the formation of the Khedivial Agricultural Society in 1897. Thirty-seven years in a double-crop country is equivalent to seventy-four elsewhere; thus we have already attained functional old age. The Society took over an area adjoining the farm of the School of Agriculture, including nearly all our present site, and on this G. P. Foaden began field experiments. In those days the "Barrage Pond" of the Nile was much smaller, so that the water table on the farm was low; there was no pink bollworm; and maximum yields up to ten kantars (1,000 lb. of lint per acre) were recorded by him. In later years the yield fell off, giving excellent opportunity for detailed

investigation of soil deterioration. Then our methods of cultivation were modified to suit the changed conditions; nine kantars was reached in 1932, and we equalled Foaden's maximum of 10·10 kantars on one set of plots in 1934. What yields Foaden might have attained with the deep soil of his day plus our refinements is a matter for speculation, but there is reason to think that some plots on the farm might then have given fourteen kantars; others could never give more than five.

The Society's laboratories were started on Gezira in 1903, where F. Hughes was joined by F. C. Willcocks and myself in 1904. The trio of chemist, entomologist and botanist made extensive use of the Giza farm, notably in the "terrace experiment" of 1909. One acre was wired off as a cotton-breeding plot, with a tent as field laboratory and occasional residence; it was known as the "cabbage-patch," and, with the terraces, was situated a few metres north-east of the present wireless masts. A garden at the laboratory on Gezira supplemented this. Part of the farm was turned over to horticulture and now accommodates the headquarters of the Horticultural Section of the Ministry.

In 1911 a Government Department of Agriculture was created, which became a Ministry at the end of 1913. It took over the chemical and botanical staff from the Society—six persons in all, including the lab-boys—and also took up part of the farm, which the Society had evacuated. Five acres were wired off and a laboratory was built on them to my designs, forming the "Cotton Experiment Station." It is amusing to recall that the expenditure on this then luxurious installation was about £1,200 for the six-roomed building (which is still in use as "the Old Lab.," now devoted to cereals) and nearly £600 on all equipment and apparatus for physiology, bacteriology, and some related physics and chemistry, as well as genetics proper; with workshop, storage, office, and bedrooms. The staff was enlarged to three in 1913, with seven fellaheen plant observers, two lab-boys, and casual farm labour.

In 1913 we expanded westward to obtain a propagation area of twenty acres, reaching the present western boundary. Water-table records and a few water analyses were made on the whole twenty-five acres, the results of which have since been invaluable for comparative purposes, because the adjacent Sawahel Canal had only been converted to perennial flow in 1910. A block of cheap stone buildings was designed, and a part built to serve as a ginnery and seed store.

Holton and myself both resigned in 1913, to be succeeded by Bolland (assisted by Bedevian and Weinstein), who attended chiefly

to Uppers cotton. That his work has had no permanent effect is due to a fear of my " pure line " methods which was very fashionable at that time, so that he was officially instructed to have no traffic with pure lines or " Mendelism," but just to do honest mass selection. Today there is a little Nahda and Casuli in Egypt and the Royal Agricultural Society's Maarad, but all the rest of the Egyptian cotton crop is pure line, renewed annually from Giza. The mass selections of Ashmouni Malaki, Zagoro Malaki, with Zagora, Pilion, Voltos, and the rest have all extinguished themselves.

After the War great changes took place at Giza, laying the framing for the present-day conditions. A new staff was engaged to restart the work, the farm was enlarged to its present size, and a new laboratory was built on its margin in 1920 to house chemists and entomologists as well as botanists. This laboratory has since had another floor added, and yet only suffices now for half the botanical accommodation and for chemistry. In order to guide the new team of novices, and render easily available to them the wealth of existing technical knowledge, a body of local experts was formed as the Cotton Research Board. Its original advisory and executive powers were necessarily ephemeral, and with the lapse of years it has changed its character entirely. As a board proper, it is now an available liaison body for contact with other departments, especially irrigation, but practically never needs to meet. As an organization it persists in the form of offices with an administrative secretary, which handle matters common to all the technical sections such as books and journals, photography, carpentry, maintenance of buildings, and the preparation of the monthly reports and meetings of our Laboratory Research Committee. The latter includes all active investigators, and serves to keep all the technical sections cognizant of each other's work and difficulties, not only with cotton, but with all agriculture.

During the active working of the Cotton Research Board, with a staff of fifteen British officials,* of whom all but two were newcomers, the hiatus since pre-war botanical work caused much loss of time in repetition, checking its vestiges for errors and gaps—like looking for holes in a colander. By mere lapse of time the workers outlived the very human official tradition that novel methods and conclusions were of necessity unsound, and the work was in process of developing its own individuality under Storey's general guidance

* C.R.B., 1921: McKillop (President), Lucas, Shearer, Hurst, Ghaleb, Hughes, Gough, Jefferys, Bailey, Gray, Storey (Secretary), Assal. Staff: *Botany*, Shearer, Bailey, Trought, Briton-Jones, Templeton, Simpson; *Agronomy*, Gray; *Entomology*, Gough, Williams, Adair, Kirkpatrick; *Chemistry*, Hughes, McKenzie Taylor, Burns.

when his death and political changes cast the whole organization into the melting-pot, out of which came a group of disconnected Government Departments.

Only one of the original C.R.B. senior staff remains in Egypt, and the various sections by 1927 were completely autonomous and too independent. They have since been relinked together for advisory and consultative purposes only, an illogical arrangement which answers very well. Work involving large-scale operations and thus predominantly administrative, rather than experimental and directional, has been passed to separate sections such as Agronomic and Crop Protection, thus correcting a tendency to unwieldiness. Even so the four technical sections proper are now substantial organizations, with a budget around £50,000 per annum, and although their expenditure is necessarily higher under local conditions than it would be in Europe, and the merit of individual workers is very unequal, they return very good value. It is demonstrable, for example, that every piastre expended on the botanical work since its inception in 1904 has been repaid by a single year's crop of Giza Seven alone.

The general view of part of the farm in Fig. 1 is taken from the roof of the main building in Fig. 2. The Pyramids are just off the plate on the left, and the wireless masts on the right. The Giza observing station of the Meteorological Service is behind the tree in the lower right corner. In the right middle distance is the Old Lab. Further away and more central are the white buildings of the ginnery, with its seed stores and the seed-control laboratory, where samples from every lot of cotton seed sown in Egypt are inspected. Between these two buildings are two acres of stainless steel wire gauze cages, of $\frac{1}{8}$-inch mesh, and $\frac{1}{100}$-inch thick, subdivided into four compartments, whence the renewal seed for each variety in turn is propagated without risk of natural crossing. Irrigation canals run right and left in the distance by the palm trees, and also in the immediate foreground; a small field distribution channel is seen on the left. The land beyond the ginnery is under a tile-drainage experiment by the Chemical Section, with an automatic recording pump installation, and routine water analyses; this is superposed on a known history of normal soil-water movements in the area. Various water-observation pits and tube wells are scattered over the area, some having been first observed in 1909 and 1912. Soil-temperature observations systematized under the old C.R.B. ran for many years, and are now taken differently at the Meteorological Station. Outside the picture on the left is the root-observation tunnel installed in 1922, from

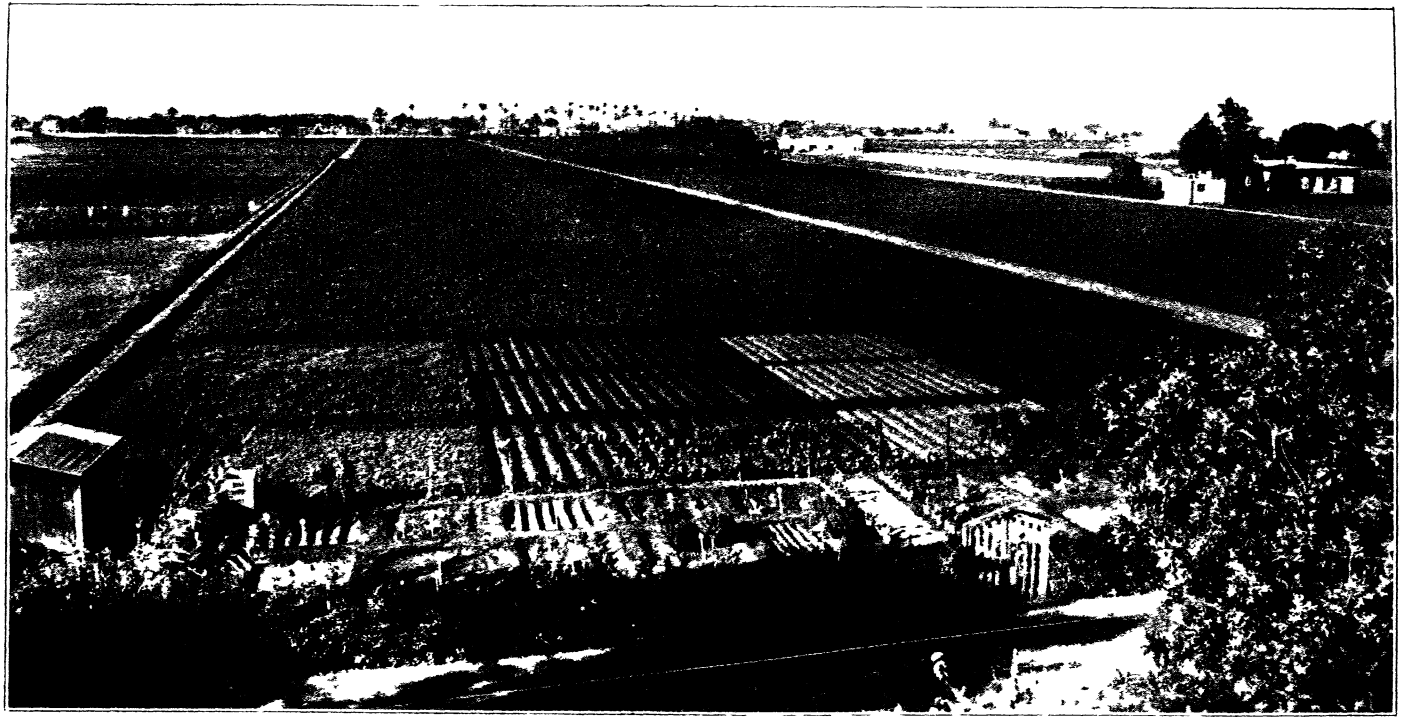


Fig. 1.—The Giza Farm.

Showing, centre to right, the ginnery, two acre gauze cages, and the old laboratory.

Photo: C. R. B.]

FIG. 2. COTTON RESEARCH BOARD, GIZA.

Showing, left to right, spinning-test mill, workshop and stores, chemical and botanical laboratories.

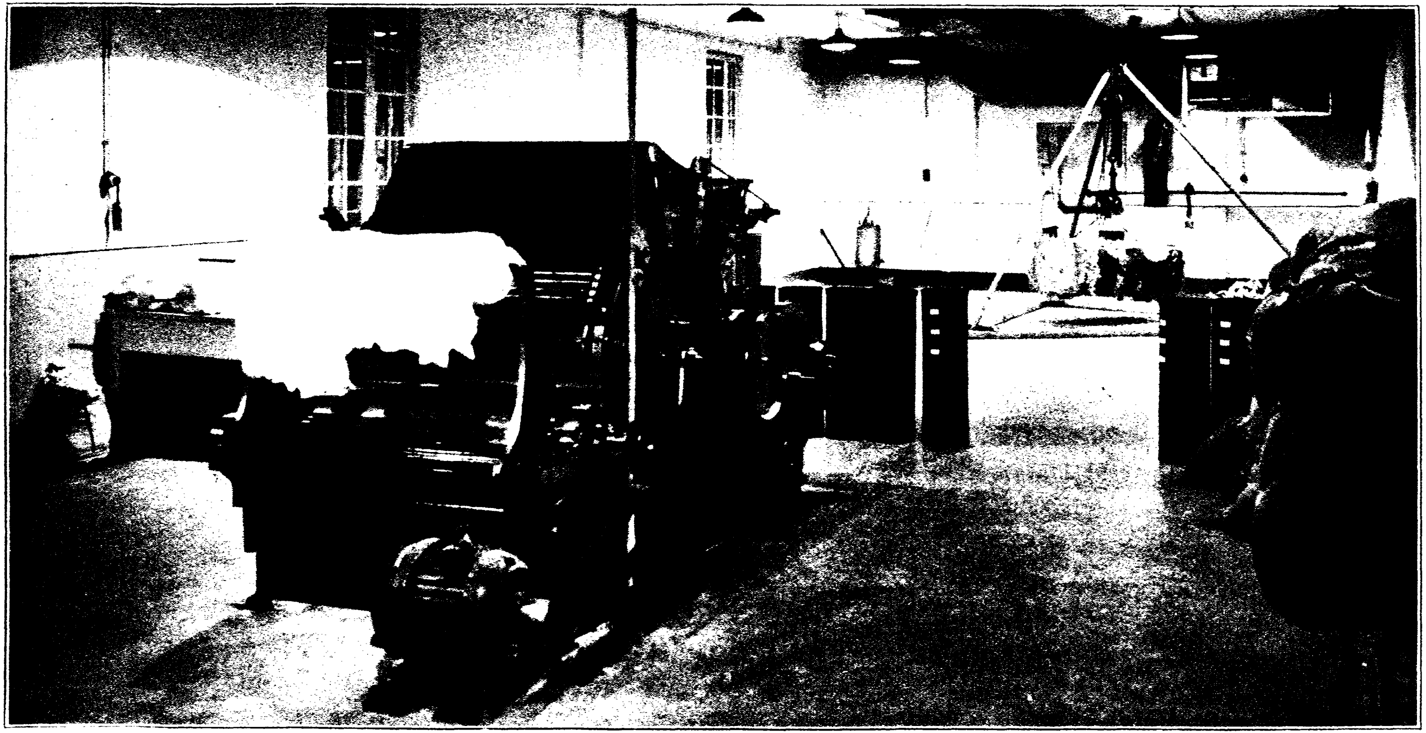


Photo: C. R. B.]

FIG. 3.—SPINNING-TEST MILL, GIZA.

The card-room.

which most valuable data on the inception of soil deterioration have lately been obtained, in collaboration with the Chemical Section.

The new building of the spinning-test mill is the latest addition to Giza. The interior of the card-room in Fig. 3 gives some impression of its extreme insulation from the Egyptian climate, effected by double walls, roofs, and windows, insulated floors, artificial lighting due to the absence of proper windows except on the north side, and an air supply (conditioned to fixed humidity) which is pumped through the ceiling ducts. A special skeleton spinning installation is being tried out, to minimize the difficulties inherent in attempting fine-spinning without skilled operatives; but there is room for expansion to a normal equipment if such is inevitable, as can be seen in the photograph. Above the ground-floor spinning machinery rooms are the testing laboratory, offices, stores (very mixed), workshop, and the fundamental humidifier plant.

This account of the place as such, though very incidental, leaves little room for an account of the cotton work proper; but the following outline, divided up into the principal classes, will illustrate its range. Meanwhile it may be noted that such publication as is effected appears mostly in the Technical Bulletins of the Ministry of Agriculture, but is very far from overtaking the work actually done; the slowness of printing in Egypt is partly responsible, while the existence of the duplicated Monthly Reports since 1928 has been another contributory factor.

It was recently suggested to me that " an account of our work on new cottons " would be acceptable. The phrase was amusing as a revelation to us of our own modesty, for it is not yet common knowledge that the known " new cottons " of Giza are old enough to constitute nearly the whole of the Egyptian crop, while those unknown ones which we strangle sooner or later after birth, even so late as the hundred-acre stage of trial development, are numbered by scores. The work includes not only selection and breeding and tentative genetic research, but widespread and elaborate routine testing for gametic purity, agricultural yield, locality preference, and spinning behaviour, culminating in trials of mercantile value, market demand, and psychology in general. All this is in liaison with crop physiology, studies of soil profiles, water tables, and manures, with research and investigations on insect pests and fungus diseases. For example, the work in mycology on wilt disease was able to telescope the study of seven generations of two families into a single season, by growing plants from the pedigree seed files of the Botanical Section, while conversely mycology tests and splits up

(if possible) all likely B.S. "pure" lines by routine wilt-resistance tests.

The pure-line concept of Johannsen is fundamental to our cotton work, and is made into a practicable administrative method by seed renewal. That the definition of a pure line is enclosed in a vicious circle does not worry us unduly; the working method is quite pragmatic, a pure line being one in which none of our available methods can show any qualitative difference inside the population. The advent of a new method, discriminating for a character previously unmeasurable, often shows genetic impurity for that character, and we now purify for wilt resistance and hair properties (quality) as well as for the old botanical characters, and for the unknown genes which regulate various measurable characteristics of the plant.

The bulk of the Egyptian cotton crop now consists of the Giza numbers 2, 3, 7, and 19, with Sakha 4 and 7. Giza 7 is cropped under its own name, as also the wilt-resistant Sakel called Sakha 4; this last has recently been further split up for hair properties, and its future renewal stock is of super-Sakel quality. The others provide the whole crop of Uppers and extra-staple Uppers, as also the crop of Sakel.

A new cotton called Giza 12 has been held up during the past three years for full consideration; this year it is being allowed to try its luck on a thousand acres; it has Sakel length with only moderate fineness, a big boll, a short habit, and the heaviest yield per acre of anything in Egypt; a sub-Sakel saleable at the price of Uppers is a queer proposition. The future of Sakel proper is rather vague; the improved line of Sakha 4 is a light super-Sakel, and another strain is available as a brown super-Sakel; both of them yield and spin definitely better than Sakel, and will probably supplant it in the special market, but they do not yield so highly as to make them cheap like Giza 7 or 12; an interesting future.

An unsolved problem being attacked systematically is the production of a true white Egyptian, whiter than any white Egyptian cotton has ever been, and good enough in quality to skim the cream off the white hosiery cotton market. We are utilizing Dr. S. C. Harland's back-crossing technique, and hope also to find genes which we need in some of his wild material from Colombia, both for white lint and for big boll. In a special product such as this it is not worth Egypt's while to introduce anything but the best; some hundred acres of makeshifts have been exterminated, though good in themselves.

Extermination does not mean total loss. A handful of seed is

preserved in cool storage at 4° C., where seven-year old controls show as yet no loss of germination. The Yannovitch variety need not have become extinct if I had arranged for this to be done when I first thought of it.

The material available for selection and breeding is now largely provided from off-types in the Target Diagrams plotted from the Purity Chequers, already described in this Review by a colleague.* We hope in the future to supplement this from Harland's collections, now that these include near relations of our Egyptian stocks; our product is too specialized for easy success in improvement by wide out-crosses with other species. A small "rubbish-heap" plot is grown occasionally, in which handfuls of everything are mixed and allowed to inter-cross; but it has not yielded anything useful so far. Isolations from field crop have now become unimportant, with the increased purity of the bulk crop of the country.

The deliberate crossing of strains for formal breeding is handled by a sub-section which has to compromise between proper genetic studies and rule-of-thumb selection. The brown super-Sakel already mentioned came from this source. In actual practice such products have to go through the routine of Purity Chequers subsequently, in order to be submitted to the delicate discriminations which the selection sub-section can apply.

The routine of testing for purity is thus, in a sense, both the beginning and the end of much of our work. During the last few years its range has been greatly extended by the development of hair-character targets, which link up with the work of the spinning-test mill; some of the problems of this combination are set out in Part III. of my "Quality in Cotton."

The routine of testing for yield is done in three stages: Miniature Chequers, Yield Chequers proper, and Agronomic Section Chequers. A new strain may drop out in any of these stages. The three Miniatures are in Upper Egypt, Giza, and on the State Domains (along with much other liaison work) in the North Delta. Some fifteen yield chequers are scattered over the whole length of Egypt, from near Assuan to the Mediterranean, on Government farms and private land according to convenience; they thus cover an interesting range of climate, as well as of soil variations. Both these chequers use yield-analysis methods, not only bollings and flowerings, but boll-weight, seed-weight and outturn, while they provide true samples for the spinning tests which have up to now been done in the Fine Spinners Experimental Department at Bollington, and at the Shirley

* C. H. Brown, "The Purity Chequer in Cotton Breeding," Vol. IX, 1932, p. 119.

Institute. None of these chequers obtain special treatment; they represent straight cultivation typical of the particular estate conditions. The miniatures compare some two dozen possible strains against standards, while the yield chequers deal only with five, six, or seven kinds. The Agronomic Section's chequers number two to three dozen localities annually, and thus obtain data representative of all Egypt on six kinds, which formerly were confined to the established varieties, but now include two or even three possible introductions under final test; these yields are not analyzed in the botanical sense.

The routine of spinning tests has been mentioned incidentally already, and needs no further comment, except, perhaps, on the revolution which has taken place since pre-war days, when the hand-judgments of expert graders was the sole court of appeal. Now we can advise the market in advance that Giza 7 is a better spinner than its appearance would indicate, or that Sakha 4 is deceptively beautiful to handle. This does not prevent the market from forming different opinions at first, but it does shorten the time required to form the correct judgment (which, of course, is ours), and it enables the Giza staff to frame and conduct an introduction policy without being stampeded from outside.

The routine of propagation for a new strain differs in no way from the annual routine of propagation for renewal seed of all the controlled varieties. It involves complex liaison with the State Domains and the Agronomic Section. The latter makes contracts of three types with landowners, each type of contract corresponding to a generation stage in propagation. These are fed initially with seed from the Botanical Section, which it has propagated under Contract A in the middle of a Contract B area, using for its sowing either "nucleolus" seed from the gauze cages at Giza (every third year), or "nucleus" seed from the A area of the previous year. In this way, passing through later contracts, the Ministry of Agriculture every year supplies pedigree seed from about one-tenth of the total area cultivated under each controlled variety. The two remaining generations are left to normal commercial handling. If—as sometimes happens—this is dishonest, the damage is ephemeral because the Seed Control organization prunes away the contaminated seed.

Seed control, which dates from 1926, is the necessary complement of seed renewal. No commercial seed may be sown until it has been sampled by inspectors, examined and passed by the Botanical Section, and sealed officially. Using the Hindi cotton seed as the principal index character, this law does valuable work, making room

for the best seed and pruning away the worst. Its statistics are most interesting, especially with respect to frauds.

Leaving Applied Genetics we pass to Crop Physiology. Here the tradition of studying the root-system at Giza continues to provide important information. The outstanding achievement of this sub-section has been to re-establish the yield levels of last century by realizing that every early flower-bud must be saved; late buds are useless, for the pink boll-worm destroys their crop whether or not the water-table would damage them had they survived. Incidentally, the modernist form of water-table trouble is in fruit orchards. The methods used so successfully in getting good yields under the new conditions are threefold. Firstly, the optimum spacing was found to be twice the pre-bollworm density. Secondly, the waterings between sowing and flowering were increased to the point of preventing bud-shedding. Thirdly, the seedling growth was allowed to proceed unchecked by the use of dibble-sowing, commonly called sand-sowing; this technique, costing nothing because it economizes seed, was devised originally in 1913, and used again after 1927 simply to save seed and to get a good stand in propagation work. Suddenly we found that it increased the yield, not merely by fine shades, but by amounts of the order of 100 lb. of lint to the acre, even on 1,000-lb. land.

Most of the water-table movement studies, as also much preliminary investigation of soil-texture variation, has been done by the physiologists.

The reader who contemplates a future visit to Giza, but whose interests are in entomology, chemistry, mycology or agriculture, need not be deterred by my insistence on botanical topics in this account of the place. The less predominant cotton interest in these other subjects is equally well sustained, but I should intrude if I attempted a detailed account.

In entomology the stories of the two major pests, pink bollworm and leaf-worm, are now known, not only qualitatively, but quantitatively to a stage at which one can draw up monetary balance sheets to set out, not the cost of production, but the cost of destruction, leaving little or nothing to guesswork excepting the human factor.

In chemistry another " Giza School " is growing for soil science, and the story of soil deterioration under irrigation conditions is developing to an extent which makes the practical development, at huge cost, of lined canals and effective field drainage, not a mere dream of Utopian cotton growing, but a serious business proposition for consideration in the immediate future.

Mycology has dealt with cotton wilt in conjunction with botany, as already described, and for the present is comparatively free of cotton complications. It expected trouble with leaf-curl out of the Sudan, but though Egypt has the white fly vector, and also the disease itself, the latter is confined to hollyhocks in the winter (and has been for thirty years), just in the same way that blackarm is abundant only in the off-season, and therefore also negligible.

Altogether, even to those who have not seen most of its development with their own eyes, Giza is a very interesting place, which has more than once provoked visitors to expressions of surprise that such a close control over the cotton crop should exist in any country. Of course, they forget how small Egypt is geographically, and how intensively cultivated.

In this account I have purposely abstained from using the names of present Giza workers to avoid unjust accidental discriminations. It would equally be unfair to give the impression that Egyptians are not participants, so that in conclusion I would like to include just those which occur to me on reading through this manuscript, as active contributors to the facts and events mentioned therein: Afifi, Bahr, Bedevian, Bishara, Brown, Enan, Fahmy, Fayek, Gedalla, Gracie, Hancock, Khalil, Kilani, Templeton, Thabit, Weinstein, Williamson, Youssef, and Zaghloul. Even this omits many less senior persons who give promise of justifying their inclusion when my successor writes on further progress in the future.

Received August, 1935.

DRAINAGE IN THE GEZIRA

A REPLY to the " Open Letter " of the July issue.

DEAR DR. GREENE, AND BAILEY,

My rash intrusion into the Gezira has yielded good. In your letter we have at last an open statement and formulation of the problem.

I appreciate very sincerely your trouble and your courtesy in replying to me. I ask you to believe my word that your reply adds nothing whatever to the facts of the problem as known (secondhand) to me before I wrote my note in the January issue of the REVIEW. All that we disagree about is the interpretation of facts.

You are accustomed by local experience to accept half a metre of weathered superficial skin on the Gezira as a fit and proper home for adequate cotton-roots, in a very severe climate. I am equally prejudiced, also by a local experience, into feeling sorry for such roots with so little opportunity for self-expression.

I have a geological hunch that the subsoil of the Gezira *might* be weathered to deeper levels, if the conditions of its existence were exactly reversed. A soil is a pretty complex system, and I cannot believe that something won't happen if you stand complex systems on their heads; reversing the direction of water-exit and oxygen-flow by means of drainage is effectively that. In fact, to quote all but one word of your own phrase, I believe that there might be " a beneficial effect if the (artificial) structure of the soil permitted greater penetration and leaching." It is true you will not admit that any water would get into a Dempster drain to effect this benefit, but you haven't tried, and science without experiment is nothing.

I experimented in pulling at an imaginary leg, by demanding an engineering trial job, rather than an experiment. Of course you are right in wanting—I am glad that you do—to experiment on Dempster drains, but I said that you must do it on the grand scale in order to get all the practical and financial factors into the experiment. I am sorry to keep on citing my friend Dempster, who gave a thoughtful sketch of a possible technique in the April issue, but the filter-joint tile-drain which he has developed is the only known type of drain which might so modify your soil as to give your crop sufficiently good living conditions underground. Then it might endure the fickleness of the Sudan above-ground, and so make good even in a bad year, reducing your seasonal variation to something less than its present range of 1¼ to 4½. But you probably appreciate the point, for I

notice that you refrain from quoting those mole-drainage trials against me.

You "are in a position to say that drainage is so costly as to be almost impracticable on a large scale." Without my suggested trial on an engineering scale you cannot be sure; none of the three of us is a civil engineer. Any more than I am in a position to say that the expense would be more than recouped by the extra yield. And why "on a large scale"?—it is the small-scale operation which is relatively costly. Based on known costs in Egypt, guessing at Sudan costs, and contemplating the snatching of profit by extra cotton crops after reclaiming, with a sound agricultural rotation of crops eventually, I make out that the finance of the whole thing would allow the whole area to be field-drained by sections in ten years without any demand for extra capital, *if* your engineering trial showed a modest increase of yield, especially in the bad years. Even geography helps you, for you can get most of your drainage outfall by gravity, whereas in Egypt we have to pump, and yet pump profitably.

I have often heard that you "do not possess clear, indisputable evidence of progressive deterioration in the soil." In pre-war Egypt the same was said to be the case for water-table effects; last year a citrus orchard died almost in a night, from water-table rise. We all tend to believe what we would like to believe; a scientifically trained subconsciousness must be very rare. But since your soil has never been a good one for cotton, not good enough to enable the crop to stand up to bad weather, I personally am content with disputable evidence, and with the need for better soil anyway. Pessimism, perhaps, but a pessimism justified by the very trouble to which you have been put by your crop.

It is all very well to blame the weather. The connection certainly exists, while your soil is as it is; but you should have seen the Cambridgeshire crops of 1933 stand up to drought on the very top of the arid chalk ridges behind this house, after the preceding bitter winter had frozen the ground for nearly two feet down. The Howards cured indigo disease in Bihar long ago by ploughing in brickbats, to give more air to the roots. So, *if* my hunch is correct, something equally exciting might happen in the Gezira with a deeper root-run.

You cite Egypt "if rapid and serious soil-deterioration should occur" in that country. Soil deterioration under irrigation is usually slow, insidious, and terribly arguable, though found all over the irrigated world. It has happened locally in Egypt, is still happening, and my colleagues at Giza are designing to avert our own troubles of fifty years ahead. Our projects are not "vital necessity," but we think they are inevitable insurance policies. As I write this I have received a copy of our Technical Bulletin No. 152 by Gracie, Khalil and Enan, which is very relevant to this discussion.

We have patches of soil in Egypt which are irreclaimable so far as our present knowledge goes. We hope to obtain the knowledge which will permit their reclamation. New patches are still forming. But, failing that full knowledge as yet, we do know definitely that they would not have deteriorated if they had been field-drained from the beginning of their perennial irrigation. A recent publication by Kenchington on other Sudan soils quotes clear evidence of eventual severe deterioration under irrigation, following a temporary improvement. The Gezira is not unique among irrigation projects.

Lastly, in mentioning the "remarkably encouraging results" from breeding resistant varieties, you raise another issue. Should Egypt have marketed its million kantars of Giza Seven under the name of "Sakel"? It could have been done, because the best Giza Seven is sometimes preferred to Sakel grown in the same chequer. I held it to be commercially unwise to do so. But if nearly all the Gezira next year is growing X1530, which is similarly sub-Sakel, does the name "Sudan Sakel" disappear from the market? And if not, why not? That is an item of expense to be included in the drainage balance-sheet, seeing that Giza is now starting the development of a sub-Sakel crop which could be sold at the same price as Uppers.

I must not make this letter unwieldy; it is only expressing personal opinions. I am grateful for the open discussion of this most interesting topic, merely academic to me, but not to you.

Yours sincerely,
W. LAWRENCE BALLS.

THE CROSSWAYS,
FULBOURNE,
CAMBRIDGE.
August 15*th*, 1935.

NOTE RECEIVED FROM DR. BALLS, DATED SEPTEMBER 6.

I have just received the *Proc. Roy. Soc. B.*, No. 809, containing a most valuable paper on "Rainfall and Cotton Yields in the Sudan Gezira," by E. M. and F. Crowther. They show that the cotton yields are highly correlated with rainfall, that seasonal and cyclic changes in rainfall are sufficient to account for most of the decline in yield, and that this is of importance because some critics such as myself, Vagel, and Alton, had concluded that irrigation without drainage had already produced serious soil deterioration. This paper makes definite and precise the facts of rainfall effect which have been recognised in principle for some years past, and in the middle of it is a sentence which provides the scientific justification for my attitude, neatly confirming my view as expressed in my reply to Dr. Greene and Mr. Bailey. It reads: "The correlation between yields and early rainfall appears to have been even closer since 1925 than in the earlier years from which it was first detected."

Putting this sentence into other words; when the Gezira soil was new to cotton cultivation, the effect of early rains upon the crop was less prejudicial than it is nowadays. When the soil was new its crop suffered less from unfavourable weather conditions than it does after some years of irrigation without drainage.

SUMMARY OF WORK ON COTTON-GROWING IN THE FIJI ISLANDS, 1926–1935

BY

R. R. ANSON,
Late Cotton Specialist, Fiji.

THE primary objective of the Cotton Experiment Station, which was opened at Sigatoka in September, 1926, was to find a substitute for Sea Island cotton, for which it was considered that there was likely to be a rapidly diminishing demand.

At the time the Station was opened, cotton prices were very high, and good Sea Island fetched about 3s. 6d. per lb. This variety, therefore, was not an easy one to replace; it was realizing top prices in the market, and was—and still is—considered the most valuable cotton in the world.

The ginning percentage, however, was not particularly high, being only 25 per cent.—that is to say, the amount of lint obtained from 100 grammes of seed cotton was only 25 grammes. The great distance between Fiji and the central markets of the world was another difficulty, owing to extremely high transport charges. In order to overcome this and the high wages paid for labour, it was necessary to have a high-priced cotton—a speciality. Sea Island had suited the case admirably, but this was out of the question because, as has already been stated, the demand for long-stapled luxury cotton was diminishing every day. It was therefore considered that the best substitute would be either a Rough Peruvian or an Egyptian cotton for which, at the time, there was a fairly good demand at fairly attractive prices.

Pima cotton had been imported in the 1924-25 season, and in the first year it grew very well and met with extremely good reports, the lint realizing 3s. per lb. on the English market. During the second season after its introduction, however, it met with particularly wet conditions, and was very severely attacked by blackarm (*Bacterium malvacearum*), with the result that the crop was a complete failure.

In the following season (1926-27), as already mentioned, the Experiment Station at Sigatoka was opened, and it was decided to import a number of varieties and to test them methodically in an

attempt to find something which would replace Sea Island. The following varieties, with the exception of the first, were imported, and all were grown side by side in duplicated quarter-acre strips, and also in quadruplicated eighth-acre plots set out on the chessboard system.

Kidney (*Gossypium brasiliense*), which was obtained from seed found growing locally, and is a perennial shrub or small tree which possesses conglomerate kidney-shaped seed and a coarse lint used for towellings and woollens. The staple measures 1 to $1\frac{1}{2}$ inches.

Meade (*Gossypium hirsutum*). A variety which originated from a single plant selection made in 1912 by Rowland Meade from a field of Black Rattler. It was introduced into the Sea Island areas of Georgia and South Carolina to replace Sea Island, which could not be grown profitably in regions infested with boll weevil. Staple $1\frac{1}{2}$ inches; silky cotton.

Tanguis (*Gossypium peruvianum*). Produced originally about the year 1908 by Señor Fermin Tanguis. It is probably a natural cross between Egyptian and Semi-Rough Peruvian, and is usually grown under irrigation. The staple is roughish and averages $1\frac{3}{16}$ to $1\frac{1}{4}$ inches.

Acala (*Gossypium hirsutum*). An American Upland variety evolved by G. N. Collins and C. B. Doyle in 1906 from imported seed from Southern Mexico. The staple measures $1\frac{3}{16}$ inches.

Pima (*Gossypium peruvianum*). An American-Egyptian variety grown mainly in Arizona and California and used for the manufacture of tyre yarns, balloon cloth, and aeroplane fabrics. Staple $1\frac{1}{2}$ inches.

Sakellarides (*Gossypium peruvianum*). An Egyptian cotton which was brought out about the year 1906 from a single plant selection from Janovitch. Staple $1\frac{1}{4}$ to $1\frac{1}{2}$ inches; silky.

New Guinea Hybrid. From selections made by Sir Geoffrey Evans from Kidney hybrid cottons found growing at Kayapet, Markham Valley, New Guinea, and probably a natural cross between Sea Island and Kidney cottons.

In the following season (1927-28) these tests were repeated, and it was found that the only cottons which could be considered of any economic value in the Fiji Islands were pure Kidney cotton, the New Guinea hybrid, and Sea Island. All the other varieties suffered from blackarm to a greater or lesser degree, and were obviously quite unsuited to the heavy tropical rains and high humidity experienced in Fiji.

During the 1928-29 season, spinning tests were carried out on

Brazilian and New Guinea hybrid cottons grown at Sigatoka. Both were found to be very coarse and irregular, and would have been a very poor substitute for Sea Island, in spite of the fact that their ginning percentage was considerably higher. It was decided, therefore, to cross the Kidney type with Sea Island, and to back-cross the New Guinea hybrid (which had probably originated from a natural cross between Kidney and Sea Island) in order to produce something which would be fairly resistant to blackarm, as it affects cotton in Fiji, and would, at the same time, be a moderately fine and long cotton saleable against Egyptians.

The first season's product was very long and fairly fine; spinners considered it too long to be spun with Egyptians. In the second filial generation it naturally split up, giving all types from the coarse Kidney to the fine Sea Island, and plants varied greatly in habit. Some nine hundred likely-looking plants were selected, selfed, and planted in progeny rows; 33 per cent. of these showed only slight variation, the remaining 67 per cent. split up, throwing many types. The ten best plants from the former types were planted out, and cotton from six of these was forwarded for spinning tests. This time the length was right, but the cotton was considered too coarse and the ultimate yarn too weak to make it compare favourably with the Sakel spun with it as a control. In the following season plants were selected for fineness; six samples were sent, and again the yarns were slightly weaker than the Sakel control, though in appearance they were a little better and compared favourably with the Casuli and Voltos cottons known commercially as OXO quality, but were not superior to them. Last season (1933-34) the lint from a set of six second back-crosses was sent to the Shirley Institute for testing, and in this case the yarn spun was much stronger than the control, but the staple was still considered too long for suitable blending with Egyptians. This, of course, can be rectified to a certain extent by single plant selection. The staple length will also drop considerably when and if the crop is put out commercially, as the class of soil upon which the majority of cotton is grown in Fiji is somewhat poorer than that of the Experiment Station.

However, it is the writer's firm belief that one cannot judge at all accurately from small samples, and as long as only small samples are available, little or no progress will be made. It is therefore recommended that this cotton be multiplied up to commercial proportions and put up for open sale on the English market. At the same time, it might be wise to plant up 250 to 300 acres of pure Sea Island each year so that should it become

saleable in any quantity, seed would always be available. Provided that the output does not exceed 200 bales, the market is not likely to be adversely affected.

Fijian Agriculture.

At an Agricultural Conference held in the Supreme Court House, Suva, on January 17, 1930, it was stated by the writer that if cotton were to be grown by Indians alone, it would be a considerable time before the output would exceed 1,000 bales. Consolidated areas settled by Indians who were not engaged in growing either sugar cane or pineapples were few and far between, and transport was difficult and costly. Cotton could not, therefore, be grown profitably by such holdings as are situated at any great distance from ginning centres. Fijians, if given a little encouragement and training, should be quite capable of producing up to 500 bales in the districts of Nadroja and Colo West alone. In order to stimulate their interest, the suggestion was put forward that it might be a good thing for the province to provide villages with agricultural implements on the understanding, or written agreement, that the implements might be paid for from the proceeds of crops at the end of the season. The time limit for payments might be extended over several seasons, according to the area and yield of crops concerned.

This suggestion was acted upon during the following year, and implements up to the value of £500 were purchased. The majority were distributed by the District Commissioner to villages in the district of Colo West. The remainder were issued to other districts, and having been paid for from provincial funds became the property of the provinces concerned and not of individuals.

An Agricultural Officer was appointed by the Secretary for Native Affairs, and posted to the district of Colo West, where he worked under the direct supervision of the District Commissioner, and a certain amount of land was ploughed and planted with cotton. The Agricultural Officer, however, was taken ill, and resigned, and his position was filled by another officer. Unfortunately, the first season was an extremely bad one; a serious cyclonic storm visited the group early in December and caused considerable damage to standing crops. Cotton was affected to such an extent that it was impossible to deduct anything from the cotton crop towards repayment for implements. During the next season the second Agricultural Officer also resigned. It was then decided by Government to transfer the working of the scheme to the Department of Agriculture

under the supervision of myself. At this period it was found that implements had become somewhat scattered, some of them having drifted away to Indian settlements, and the Fijians, having experienced a number of complete failures, had become quite discouraged and lost all interest. It was evident that in order to revive their interest it would be necessary to hold a large meeting and talk things out. This was done, and thanks to the energy and enthusiasm of my Assistant Agricultural Officer, the natives became enthusiastic once again, and four main training centres were established. All the implements were recalled, branded with serial numbers, and redistributed to training centres, each of which had an average of twenty Fijian youths who had volunteered for the work. Each area, or centre, had approximately one hundred acres of good land which had been voluntarily handed over to the scheme by the owners. No more than half this area was put under cultivation at one time, and a three-year rotation was organized embodying money crop, food crop, and legume. Fijians trained at the Cotton Station, which by this time had developed into a general Experiment Station for crops on the dry side of the island, were appointed as instructors in charge of each centre, and "Headmen" were nominated by free choice of the youths working the centres. Arrangements were made for the transport and marketing of money crops, which consisted mainly of rice, cotton, potatoes, maize, groundnuts and tobacco.

This state of affairs lasted for two years, during which between 150 and 200 Fijian youths were taught to plough. At the end of this time such youths as had remained with the scheme from the beginning requested that they might be allowed to commence farming on their own, and become, as it were, independent farmers. This meant a thorough reorganization and redistribution of implements, on which only one-third of the total sum owing had by this time been collected. It was finally decided to divide equally the implements paid for and the debts owing. This was done proportionally, and individual settlements were established. Then came the question of taxes. It was strongly recommended that individuals who were definitely attached to the scheme should be excused taxes and all communal work except actual village work, in order to enable them to get a start. The Government felt unable to exempt any of the youths from paying taxes, but agreed to compromise in that an extension of time was given so as to allow each individual to plant and harvest one crop before he was called upon to pay his taxes. These, comparatively speaking, are fairly heavy, and consist of £1 per head Government tax, £1 provincial tax, and usually 3s. for

Government survey fees. These fees vary according to the amount of survey work which has been done in the district to which the individual belongs.

Eventually, thirty-seven farms were established, and youths sorted themselves out according to the particular tribe to which they belonged. Most of them worked in groups of twos and threes. Each tribe appointed its own Headman, whose duty it was to keep discipline, to act as spokesman for the tribe, collect payments for produce sold, and generally help in the organization of the scheme.

Working Capital.

The great bugbear was the complete lack of working capital necessary for the purchase of bags, seed, fencing wire and repairs to implements, etc. However, as this could not be raised, it had to be done without as best it could. Sums up to £10 from each province were sanctioned and set aside as a guarantee against bags purchased on credit from local stores, and these bags were paid for after sales of produce had been effected. The cost of repairs to implements had to be recovered in a similar manner.

Eventually Government agreed to treat the original £500 advanced as floating capital, which meant that money recovered on the implements distributed might be spent on purchasing new ones. Development is therefore restricted, and, governed as it is by new purchases made in this manner, naturally somewhat slow. Only 25 per cent. of the total value of produce sold is placed towards the credit of implements advanced.

Conclusion.

The natives connected with the scheme are very enthusiastic about it, but its ultimate success or failure will also depend to a large extent upon the enthusiasm and endeavour of the officer in charge.

The inauguration of the scheme was due in large measure to the personal efforts of my European Assistant, who is shortly to be transferred to another district where large areas of moderately fertile land are available, and where a further scheme is to be commenced on similar lines. Progress will be governed by available capital and by the possibility of readily marketing crops grown. Should two marketable money crops be forthcoming, progress should be fairly rapid. Large areas of undeveloped land are available, and very shortly, when road development is completed, a considerable

number of natives will be looking for ways and means of obtaining money for taxes. One point, however, adds slightly to the difficulties of the scheme, and this is that sugar, the primary crop of the country, is usually taken as a basis of comparison by the natives, the economic value of crops grown being judged accordingly, and since sugar enjoys a preferential tariff, it is rather difficult to find a crop which will give better returns per acre. Should Fijians, however, really take to cotton growing, they would be capable of producing a considerable quantity, but they are a proud race and must be led: they cannot be driven.

Received August, 1935.

OVERSEA MECHANICAL TRANSPORT

TRIALS OF THE 15-TON UNIT IN AUSTRALIA

BY

CAPTAIN E. C. ROSCOE, M.B.E., A.M.I.Mech.E.

An article entitled "Oversea Mechanical Transport," which appeared in Vol. X., No. 4 of the Empire Cotton Growing Review, describes the activities of the Oversea Mechanical Transport Directing Committee and gives details of the second 15-ton unit evolved by them, the trials of this unit being then in progress in England.

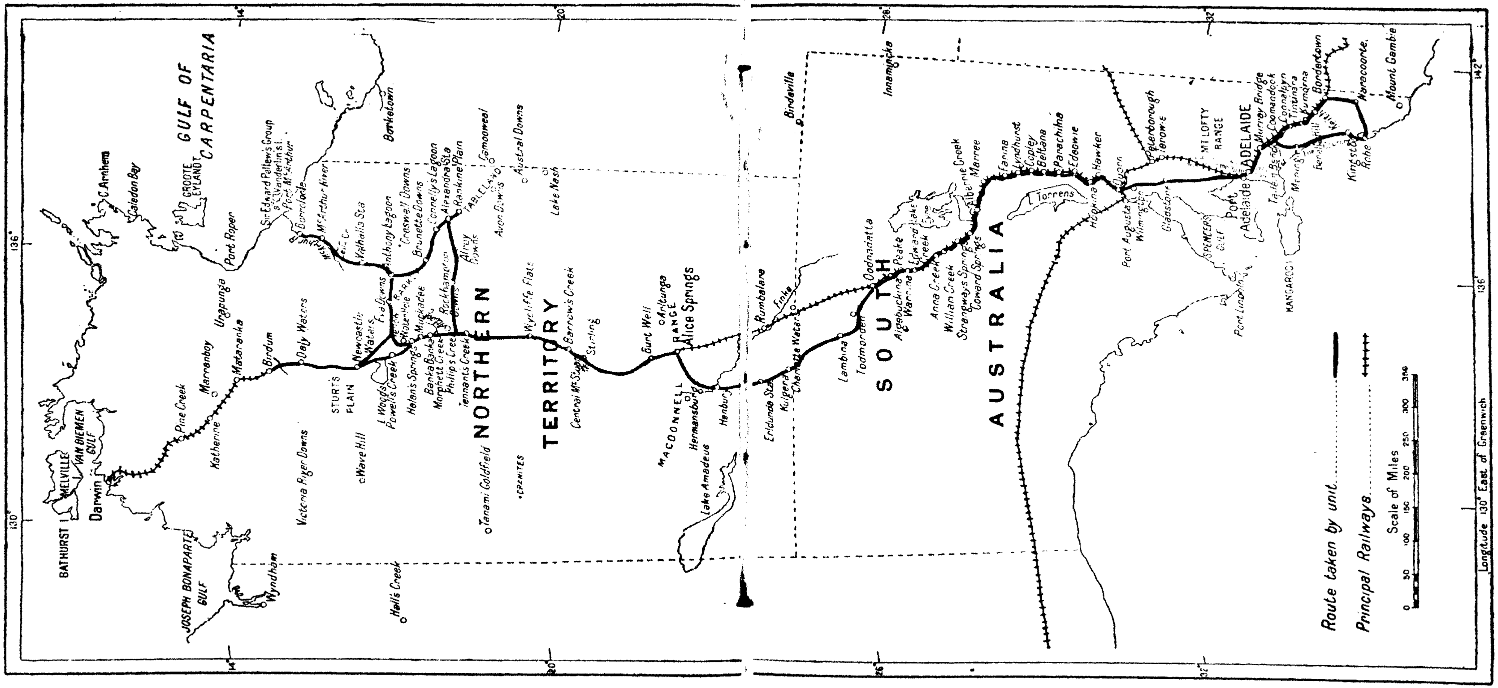
Perhaps a few details of the unit, which is to enable heavy loads to be carried over soft earth roads without damage to the roads or sinkage of the wheels, will be of interest if repeated here.

The unit consists of three vehicles, a tractor, which carries a useful load of 3 tons, drawing two trailers each carrying useful loads of 6 tons. All the vehicles are mounted on eight articulated wheels shod with 10·50-20 inch tyres; the gross axle weight does not exceed 3 tons.

The power unit of the tractor is a six-cylinder A.E.C. heavy oil engine developing 130 b.h.p. at 2,300 r.p.m. The radiator is of the "Still" tube type, mounted at the rear of the driver's cab, air being driven through it by means of a six-blade 33-inch diameter fan. In this position the radiator cannot be damaged by collision with trees or other obstacles and is well away from grass seed, which is so liable to block up the airways when it is in the normal position in front of the vehicle. The steering of the tractor is effected by means of the first and fourth pair of wheels. All wheels are driven.

The trailers have 20-foot platform bodies mounted on two four-wheel bogies. These bogies are interconnected by means of a diagonal link, so that when the leading bogie is turned by the drawbar and steering yoke, the rear bogie is turned in the opposite direction; this gives true track steering, the trailers being able to follow accurately in the track of the tractor round corners. The trailers cannot "weave," that is sway from side to side.

The brakes are of the Westinghouse air pressure type and are arranged to operate on the trailers first and the tractor last, thus


GULF OF CARPENTARIA
NORTHERN TERRITORY
SOUTH AUSTRALIA
Darwin
Alice Springs
ADELAIDE
Port Adelaide
MACDONNELL RANGE
MT LOFTY RANGE
STURTS PLAIN
JOSEPH BONAPARTE GULF
VAN DIEMEN GULF
BATHURST I
MELVILLE I
GROOTE EYLANDT
KANGAROO I
SPENCERS GULF
L. Torrens
Route taken by unit
Principal Railways
Scale of Miles
Longitude 130° East of Greenwich

obviating any tendency for the trailers to push the tractor round on steep hills when the brakes are applied.

The loaded tractor weighs 11 tons 15 cwt., and each trailer 10 tons. The unit fully loaded with 15 tons will climb a gradient with a moderately firm gravel surface of 1 in 6½, while the tractor alone carrying 3 tons will climb a grade of 1 in 2½. The turning circle diameter of the unit is 58 feet.

The tractor was constructed for the Committee by the Associated Equipment Company and the trailers were built by R. A. Dyson and Company.

It was decided after a preliminary trial of 3,000 miles in England to complete the oversea tests in Australia, the Commonwealth Government having kindly offered to assist in every way possible to enable them to be carried out on a proper commercial basis in the Northern Territory, which they were commencing to develop. A mileage of approximately 10,000 was to be run, and this was to be accomplished within a space of six months.

The Northern Territory, formerly known as Central and Northern Australia, has an area of 523,000 square miles, or, to express it in another way, it is two and a half times the size of France and four and a half times that of Great Britain. Alice Springs, which is within a short distance of the very centre of the continent, was chosen as the base from which the unit should work.

The Central Australian Railway, over which a fortnightly mixed train service is run from Adelaide, has its terminus 1,040 miles away at Alice Springs. From here northward to Birdum, which is the southern terminus of the North Australia Railway from Darwin, there is a great gap of 700 miles. It was this gap that we were destined to bridge.

The vehicles were unloaded at Port Adelaide from the *Largs Bay* in April, and as the South Australian Government had expressed a wish for a short demonstration of the capabilities of the unit to be made in the neighbourhood of Adelaide prior to the commencement of the journey north, it was arranged, in conjunction with the State Transport Board, for a run to be made to Bordertown and back, situated in the wheat-growing district in the south-east corner of the state.

The outward route, 191 miles, via Tintinara, is over one of the worst tracks in South Australia after the first 90 miles. The return route, 300 miles, via Robe, is over more or less made roads. The journey was successfully accomplished under very bad conditions, and good experience was gained of the performance of the unit

under rather trying circumstances. Fifteen tons of superphosphate were carried on the outward journey and 14½ tons of wheat on the return journey.

A fortnight was then devoted to a careful examination on paper of the 1,100-mile route to Alice Springs and the interviewing of those who claimed to have travelled over some part or the whole of the track. There was also a constant stream of interested people who wished to inspect the vehicles. The unit was at the same time looked over, the necessary camping equipment purchased, and all stores as well as 13 tons of fuel carefully stowed on board. A South Australian was engaged as a guide and cook. This man later proved to be an excellent shot, and it was mainly due to him that we were kept well supplied with wild turkeys, and kangaroos for those who appreciated that delicacy, kangaroo-tail soup. Besides him there were the driver and spare driver, who had travelled out from England with the vehicles. Captain Dollery of the Australian Defence Force and a Press representative also accompanied us, but only as far as Alice Springs.

We left Adelaide on the last day of April. The first 200 miles as far as Quorn is over moderately good macadam roads; thereafter for the remaining 1,800 miles across the continent to Darwin there is no made road, only a couple of ruts following the general line of the Overland Telegraph. At this time of the year—the winter—all rivers and gutters (small streams) are perfectly dry in Central Australia, and these crossings tested the draw gear of the unit to its utmost, but thanks to the ample articulation of the wheels of the vehicles no serious difficulty was experienced in negotiating such obstacles.

Tents were used for our first camp, but with further experience of the country we soon discarded them, and adopted the bushman's way of laying our swag (blanket and waterproof sheet) on the ground, or on a camp stretcher and sleeping beneath the stars. I did this nightly for seven months, such is the wonderful climate.

Desert country is traversed onwards to Oodnadatta, and the monotony of the daily vista of sand and stones with no vegetation as far as the eye could reach was at times depressing. At Farina, now a desolate little place with sand drifts against the few small bungalows and huts that remain inhabited, I was interested to see at Bell's store the relics of a Renard road train. It consisted of a arge tractor and two six-wheeled trailers, all with iron-tyred wheels. The drive from the tractor was transmitted to each trailer in series by means of a cardan shaft. This road train was brought out to

Farina twenty-seven years ago from France, and it was hoped it would do useful work at the copper mines some thirty miles away. However, after only three journeys the sand proved too much for it, and it has lain derelict ever since.

A day for maintenance was spent at Coward Springs, so called on account of the disused bore from which natural hot water continually flows.

From Oodnadatta there are two alternative tracks to Alice Springs—the old one following the Central Australian Railway via Charlotte Waters and the Depôt Sand Hills, and the new one some 90 miles west through Erldunda cattle station and Henbury. The latter track was taken, as the crossing of the Depôt Sand Hills—razor-backed sand dunes, fifteen of them in as many miles—would have been impossible. As it was we encountered much sand on the western route, and our rolls of cocoanut matting were frequently used. Between Henbury, where the famous Finke River is crossed, and Alice Springs many dried-up rivers are met with, and on the last stage of this journey there were as many as eleven crossings in 22 miles. Alice Springs was reached on the 18th of May at midnight, the journey from Adelaide having occupied seventeen days, including two taken up for maintenance and rest. The average speed was 12·3 miles per hour.

As a great part of the loading carried by the unit had been arranged by the Commonwealth Government in advance, no time was lost before the first journey north from Alice Springs was commenced. Fourteen tons of building materials for the construction of the hotel at Tennants Creek were loaded, and the 325-mile journey started on the fifth day after arrival.

The track to Tennants Creek for the first hundred miles is moderately good, consisting chiefly of a natural laterite surface, and thereafter there is a variety of stony and sandy going with one bad sand-hill and one wide river crossing—the Taylor. Tennants Creek consists only of an overland telegraph office, but 7 miles south a promising goldfield is being slowly developed. A corrugated iron store, a petrol dump and a few brushwood shacks were all that I saw on my first visit, and the population, all men, was 170. The hotel—concrete (mostly sand) and corrugated iron—was erected in a couple of months. Now, a year later, a police station, a hospital, and a school are being built, and the population is nearly 500, with many women and children. Water is scarce and is retailed in the goldfield at 10s. per 44-gallon drum. It will be realized that there is a considerable amount of traffic between the railway terminus

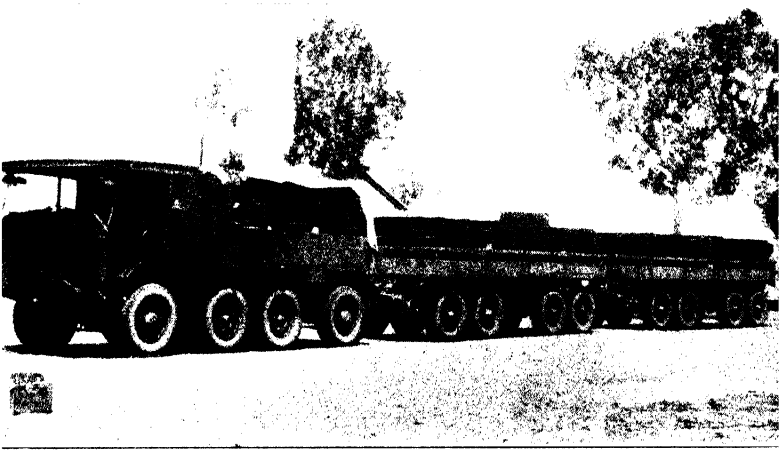


Fig. 1.—Unit Loaded with 3,000 Gallons of Petrol: Birdum.

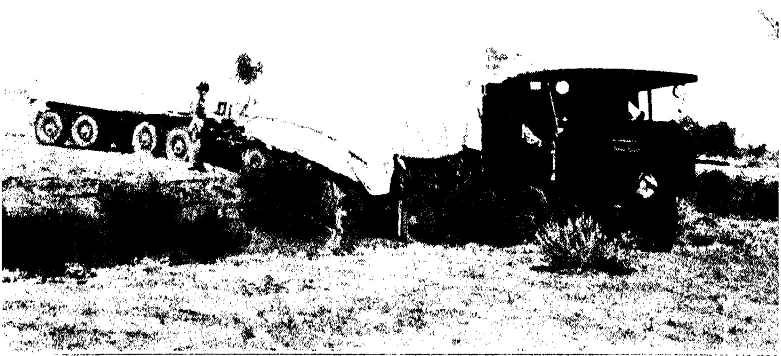


Fig. 2.—Crossing a Gutter South of Oodnadatta.

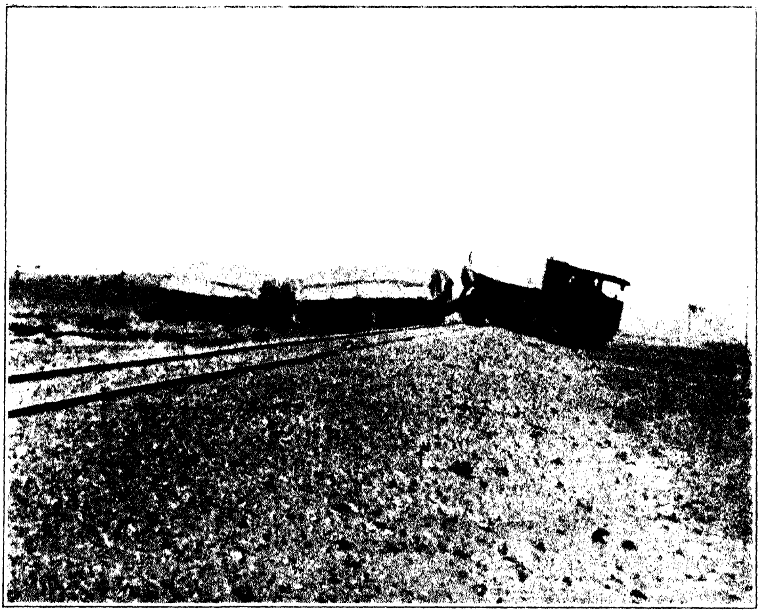


Fig. 3.—Crossing the Central Australian Railway.

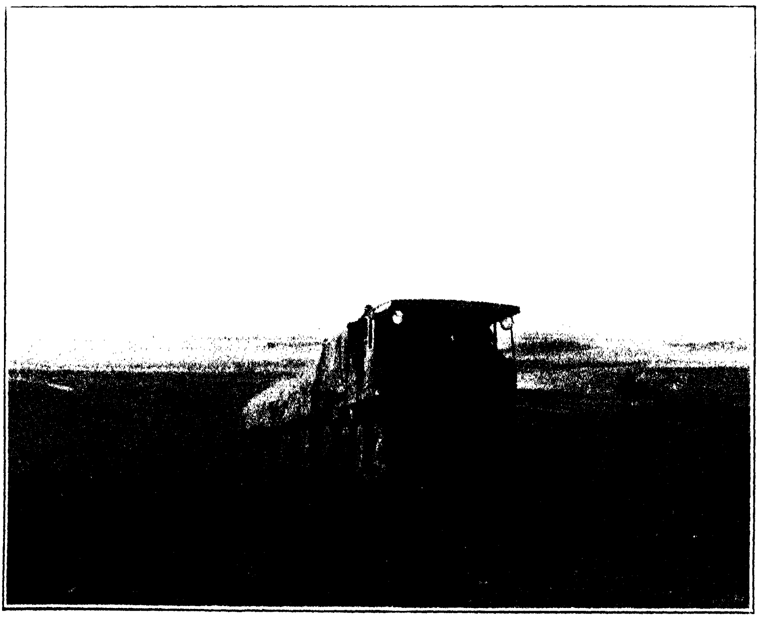


Fig. 4.—Desert Country near Marree.

at Alice Springs and Tennants Creek, but the owners of the few G.M.C., Ford, Chevrolet and Bedford trucks in use demand high charges, 1s. to 1s. 6d. per ton mile, and this is one of the main causes for the slow development of this part of the country. Camel trains are often seen, but, on account of its slowness, this form of transport is growing less. There were no return loadings of gold ore, since, on account of the high freight charges on rail from Alice Springs, it did not pay the prospector unless values of over 2 ounces to the ton were obtained. A battery is in existence at Tennants Creek, but it is nearly always out of order, and a larger one has now been installed.

Besides the loading previously arranged for by the Department of the Interior, many demands began to be received from other consignees who were desirous of availing themselves of this cheap form of transport, a charge of 6½d. per ton mile for outward journeys and 3½d. for return loading being made. It was soon proved that a second 15-ton unit could have been kept hard at work had it been available.

A later journey north from Alice Springs was to Newcastle Waters, and from that centre we had freight commitments over distances of 2,000 miles to fulfil. The outward load on this occasion consisted of fuel oil for dumps, and station stores (tea, sugar, salt and flour) for Newcastle Waters cattle station. Owing to the vast stretches of uninhabited country in which we were working, a month's supply of food for four persons and 56 gallons of water for drinking and other purposes were always carried for our own use. Generally the water found in any creek or water hole could be drunk unboiled without ill results, but these places were very few and far between in such an arid country.

At Newcastle Waters there is a large cattle station, a combined police station and telegraph office, two Works Department huts, a couple of small stores and a tiny hotel, the total white population being fourteen. Aborigines—Abos or blackfellows as they are called —are employed on the cattle stations and make good stockmen. The native women are employed for washing and work in and about the camp. The natives receive no pay, but have to be clothed and fed by those employing them.

Forty-five tons of lancewood rails and cement for the construction of a Government cattle dip and yard was another consignment dealt with between Newcastle Waters and Muckadee. It was when running on this route that we met the greatest number of kangaroos. Emus and "native companions," otherwise called

"brolgas," were often seen, and a few shots were had at some dingoes, or wild dogs, for which the Government offer 7s. 6d. a scalp. There were plenty of wild turkeys as well.

Loads of fencing and barbed wire, windmill pumping plant, cattle troughing and food supplies for the local stores were transported from the railhead at Birdum. 10,000 gallons of petrol and lubricating oil were also picked up there and taken to the Newcastle Waters aerodrome for the England to Australia air race, and two large 1,500-gallon bowser tanks to Daly Waters aerodrome for the England to Australia air mail service.

It was at this time that I had occasion to experience the great benefit to the Northern Territory of Dr. Fenton, the Government "flying" doctor, stationed at the hospital at Katherine. One of my drivers was laid low with an acute attack of dysentery while at Newcastle Waters. I sent a telegram to the doctor, stating the urgency of the case, at 9 a.m., at 11.30 a.m. I received a reply to say he was starting, and at 3 p.m. he arrived at the landing ground. He saw the patient, had him placed in his Moth biplane, and by 7 p.m. the same evening the driver was safely in bed at the hospital at Katherine 300 miles away.

Up to this time the weather had been very dry, but it now changed and heavy rain fell for four days; this necessitated a halt. As soon as the rain ceased it is interesting to note that the tractor and trailers were able to recommence their journey at least a day before any of the light 2-ton lorries similarly held up could move.

Opportunity was taken when back in Alice Springs in August to look over the unit. Some road spring bushes on the trailers were renewed and two drawbar pins replaced, the very abrasive character of the dust having caused a good deal of wear to the old ones.

The next journey north was with two complete windmill pumping plants, bore casing and troughing for Rankine Plain and Connelly's Lagoon on the Barclay Tablelands, a straightaway haul of some 500 miles. On the way, Alexandra cattle station, which is 10,000 square miles in extent, was visited. The Barclay Tablelands, a vast treeless area, consists chiefly of black soil, and during the dry season the tracks across it are good, but it is quite impassable in the rainy weather. As there was no natural shade and the thermometer was generally above the 100° mark, the midday meal was usually taken sitting right underneath the vehicles. Snakes and "goannas" (very large lizards) were frequently met with.

The Commonwealth Government were anxious that the unit,

before completing its trials, should be tested over the track running between Anthony Lagoon and Borroloola. The distance is 178 miles, and most of the route is through hilly country with many miles of rocky outcrop and sandy soil known as "bull dust." In addition many steep-sided river crossings are met with.

Borroloola is situated on the McArthur River, Gulf of Carpentaria. It consists of a police station fitted out with a small wireless transmitting set, a store, a disused court house and the inevitable hotel. About 60 tons of freight, including four windmill pumping plants with bore casing and troughing, dog-proof fencing, and station stores, awaited us. The methods of delivering the goods at Borroloola were very rudimentary. No facilities or accommodation of any description were available, the freight from the small 31-ton auxiliary ketch, the *Noosa,* was merely discharged on to the grassy river-bank, and then carried up a steep sandy bank to higher ground, where it was loaded into the unit. This fact, together with the delay at midday due to the hot sun, added considerably to the loading time. It was on one of these trips that a large boulder weighing several hundredweight had to be removed from the track. After excavation we dragged it clear by means of two chains attached to the tractor. It was hot work, so hot in fact that we lost our appetite for lunch and one tin of peaches sufficed for all of us.

The period for the duration of the trials had now been exceeded, and it was necessary to return to Alice Springs as quickly as possible. The wet season in the north was approaching, so day and night running had to be resorted to to reach the drier zone near Tennants Creek. Alice Springs was finally reached at midnight on November 19th, thus bringing the trials to a successful conclusion.

Although the unit crossed the Australian continent from south to north during its trials, travelling over very diverse conditions of country, and crossing endless rivers and creeks, it is gratifying to record that at no time during the 9,900 miles was it necessary to procure external assistance in order to overcome any difficulties of the route. The A.E.C. heavy oil engine gave no trouble during the whole of its trials; only one involuntary stop was made, and this was due to a stuck-up injector, the loss of time occasioned being only twenty minutes. The tyres gave no trouble, and only five punctures were experienced—each being due to the piercing of the outer cover by a sharp piece of dry wood.

The trailers carried their load well, and stood the racking and distortion, so often imposed on them when crossing deep gutters, without the fracture or bending of a part. The true tracking features

enabled all sharp turns and the negotiation of the difficult parts of the track between trees to be effected without trouble.

The following is a brief summary of the tests in the Northern Territory, not including the trial run to Bordertown.

Mileage	9,387
Ton mileage	81,933
Average speed, m.p.h.	12·87
Maximum speed, m.p.h.	25
Average fuel consumption, m.p.g.	3·15
Actual cost per net ton mile (pence)	3·70

Whilst on all outward journeys the unit was loaded to its full capacity of 15 tons and sometimes carried as much as 20 tons, little back loading was obtained, with the result that the average load was only 8·72 tons. The actual cost of 3·70d. per ton mile would, of course, have been considerably lower had the average loading figure been higher.

The trials are considered to have been most successful, and the satisfaction of the Australian Government in the performance was expressed by their purchase of the unit.

Two 15-ton units have since been supplied to the Government of Soviet Russia, whilst a third is under construction for the Government of Tanganyika.

Received August, 1935.

COTTON STATISTICS

BY

JOHN A. TODD, M.A., B.L.

During the summer the cotton position has been largely dominated by the continued uncertainties of the legislative position in America, which followed the decision of the Supreme Court against the constitutionality of the N.R.A. So far as cotton was concerned the main question was whether the unconstitutionality would be extended to the Agricultural Adjustment Administration, including the Bankhead quotas and the Processing Tax. The last mentioned has already been successfully challenged in an inferior court, but the final decision lies with the Supreme Court. In the meantime the Act to amend the A.A.A. has passed through many contradictory phases, the chief point of contention being the revival of the Export Bounty proposal, which dates back as far as the McNary-Haugen Bill of 1927. Finally, however, it was decided that this should not apply to cotton.

In the meantime the Government steadfastly refused to announce their loan policy for the 1935 crop until the statistical position became clearer with the publication of the August Bureau Report. The acreage figures published on July 8 were surprisingly small, the total of 29,166,000 acres planted showing an increase of only 4·6 per cent. on last year's revised figures. Throughout the early summer the weather was unfavourable with heavy rains in May and June, but in July the crop made a good recovery, with the result that the August Bureau showed a crop figure of 11,798,000 bales. This meant an average yield per acre of 198·3 lb., which is within a decimal point of the previous record for August of 198·4 lb. in 1933. As will be seen from the figures given in our first table, this creates a very remarkable succession of poor crops and bumper crops in regular alternation over the last six years, for, barring accidents, the final yield of this crop should again exceed 200 lb. per acre.

Egyptian.—For no other crop are estimates available so early as in the case of American. Thus our second table of the Egyptian crop, which gives the full details of the 1934-35 acreage and yield by varieties, contains only the acreage figures for the new crop. These, however, were rather surprising, for the general expectation that any further reduction in Sakel would be set off by an increase

in other varieties was not borne out, and the total acreage showed a net reduction of 63,000 feddans.

Indian.—The same applies to the Indian crop. The August forecast, which is the only one yet available, applies only to about 60 per cent. of the total area, but so far as it goes the figures show an increase of 12 per cent. on last year's revised figure at the same stage.

Our table of the Indian crop, therefore, is confined to the revision of the details of the last two crops with the addition of the Commercial crop for 1933-34, which, incidentally, again shows a very large excess over the Government estimate. For the 1934-35 crop, of course, the Commercial crop figures are not yet known, but it may be noted that Ralli's final estimate of that crop was 5,711,000 bales against the Government's estimate of 4,807,000.

American Carryover and Consumption.—Our next table of the World's Carryover of American cotton brings the position down to the close of season 1934-35, and shows a total of 9,078,000 bales, or 1,431,000 less than a year ago. This comparatively high figure is partly due to the reduced consumption in America during the last two months of the season owing to the official restriction of spindle activity. That began in the last week of April, but the full effect was not shown till the June figures. The season's total of 5,224,375 bales is included in the table of the world's consumption of cotton of all kinds. The position of these world's consumption figures is becoming increasingly unsatisfactory owing to the fact that throughout the whole of this season the Federation has been unable to get the German figures, and the Russian figures, of course, have not been available for some years. The Federation were not even allowed to include an estimate of the German figures, as they do in the case of Russia. As explained in the July issue, however, when we gave the Federation figures for the first half of this season, the lack of the German figures so completely invalidates comparison with previous years that we thought it better to include the average figures of the previous five years for Germany as an estimate. There is, unfortunately, a considerable risk of error in this estimate in the distribution between Germany's consumption of American and Outside Growths, but that error is not likely to make any very large difference in the comparative totals of the world. That comparison for the second half-year only carries still further the extraordinary position which had developed during the first half of the season. The total world's consumption of American cotton is estimated at only 11,748,000 bales, while that of Outside Growths has reached the unprecedented figure of 13,936,000 bales. As a check on these estimates it may be noted that the statistician of the

New Orleans Cotton Exchange made the world's consumption of American cotton 11,325,000 bales during the season, while Garside of the New York Cotton Exchange estimated the consumption of American at 11,314,000 bales and Outside Growths at 14,150,000 bales. Such a position of relative consumption of American and Outside Growths is, of course, absolutely without parallel in history.

Prices.—During July, prices had made some recovery from the relapse which followed the Supreme Court's decision on the N.R.A. Codes, but the unexpectedly large figure of the August Bureau, followed by the Government's announcement of their loan policy, produced a sharp drop. The new loan was finally fixed at 10 cents (against 12 cents last year), but planters who sell their cotton in the open market are to receive a bonus, calculated on a rather intricate basis of average spot prices, but limited to 2 cents a pound.

The movements of the prices of other varieties relative to American have been rather irregular, but on the whole the tendency has been for them to lag behind American, so that when the price of American fell the percentage premiums of other growths tended to stiffen.

AMERICAN CROP (EXCLUDING LINTERS).

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934–35.
Acreage planted (000's)	44,458	43,339	39,109	36,542	40,852*	27,883
Acreage harvested ...	43,242	42,454	38,705	35,939	29,978	26,987
Crop (running bales)...	14,548	13,756	16,629	12,710	12,664	9,472
Yield per acre (lbs.) ...	164·1	157·0	211·5	173·3	208·5	170·9
Season's average spot price (Liverpool—pence per lb.) ...	9·09	5·71	4·82	5·62	6·02	—

PROGRESS OF THE SEASON 1934–35.

	August.	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*March.*
Acreage planted ...	29,166	29,166				
Acreage harvested ...	28,480	28,652				
Crop (500 lb. bales) ...	11,798	11,489				
Yield per acre (lbs.)...	198·3	192·0				

* Less 10,396,000 acres special abandonment.

EGYPTIAN AREA AND CROP BY VARIETIES.

(THE CROP ESTIMATES EXCLUDE SCARTO.) 000'S OMITTED.

	1933.			1934.			1935.
	Area: Feddans	*Crop: Kantars*	*Average Yield*	*Area: Feddans*	*Crop: Kantars*	*Average Yield*	*Area: Feddans*
Long Staple:							
Sakel	391	1,153	2·95	420	1,022	2·39	297
Maarad	110	377	3·44	54			82
Giza 7	124	440	3·54	287	†	†	270
Sakha 4	46	149	3·21	10			28
Casouli	3	13	4·06	3			3
Group Total	675	2,132	3·16	774	2,238	2·89	679
Per Cent. of Total ..	*37·4*	—	—	*44·7*	—	—	40·7
Medium:							
Nahda	27	93	3·44	10			5
Fouadi	49	101	2·05	39	†	†	32
Pilion	31	158	5·04	8			—
Giza 3	7	12	1·82*	10			10
Group Total	114	365	3·19	67	212	3·17	47
Per Cent. of Total ..	*6·3*	—	—	*3·9*	—	—	2·8
Short:							
Ashmouni and Zagora ..	1,010	5,881	5·82	885	†	†	938
Others	5	33	6·84*	6			5
Group Total	1,015	5,914	5·83	891	4,961	5·57	943
Per Cent. of Total ..	*56·3*	—	—	*51·4*			56·5
Total	1,804	8,411	4·66	1,732	7,391	4·27	1,669
Per Cent. Change in Acreage	*+64·9*	—	—	*-4·0*	—	—	3·6
Lower Egypt	1,240	—	—	1,175	—	—	1,113
Upper Egypt	565	—	—	557	—	—	556
Per Cent. of Total ..	*31·3*	—	—	*32·2*	—	—	33·3

* These figures seem to require correction. † Details not yet available.

INDIAN CROP.

(000's *Omitted.*)

	1929–30.	1930–31.	1931–32.	1932–33.	1933–34.	1934-35
Area (acres)	25,922	23,812	23,722	22,483	24,136	23,830
Crop (Government estimate) 400-lb. bales	5,243	5,226	4,007	4,656	5,068	4,807
Average yield per acre (lbs.)	81	88	68	83	84	81
Staple ⅞ and above (bales)	1,428	1,271	1,343	1,396	1,480	1,340
Per Cent. of Total ...	*27·2*	*24·3*	*33·4*	*30·0*	*29·2*	*27·9*
Staple below ⅞ (bales) ...	3,815	3,953	2,682	3,260	3,588	3,467
Per Cent. of Total ...	*72·8*	*75·7*	*66·6*	*70·0*	*70·8*	*72·1*
Commercial Crop:						
Net exports (bales) ...	3,868	3,729	1,582	2,868	3,269	—
Mill consumption ...	2,373	2,271	2,346	2,361	2,336	—
Domestic consumption ...	750	750	750	750	750	—
Total	6,991	6,750	4,678	5,979	6,355	—
Per cent. on Government estimate	+33·3	+29·2	+16·7	+28·4	+25·4	—
Season's average spot price (Liverpool—pence per lb.)	6·39	4·02	4·32	4·84	4·52	—
Per cent. on American ...	70·3	70·4	89·6	86·1	75·1	—

WORLD'S CARRYOVER OF *AMERICAN* COTTON.

(Running Bales 000's, excluding Linters in U.S.A.)

End of	*Stock and Afloat.*			*U.S.A.*					
	U.K.	*Continent.*	*Orient.*	*Mill Stocks.*	*Public Warehouses.*	*Monthly Totals.*	*Federation. Other Mill Stocks.*	*Half-Yearly Totals.*	*Elsewhere in U.S.A.**
1929, July ...	442	563	—	932	923	2,860	1,197	4,332	275
1930, January ...	618	1,198	448	1,730	5,343	9,337	1,007	10,344	—
July ...	304	544	143	1,048	2,803	4,842	937	6,249	470
1931, January ...	644	1,198	343	1,523	7,895	11,603	907	12,510	—
July ...	436	766	401	922	4,491	7,016	950	8,816	850
1932, January ...	506	938	805	1,583	10,019	13,851	1,193	15,044	—
July ...	415	729	695	1,163	6,657	9,659	1,379	12,798	1,760
1933, January ...	620	1,189	852	1,455	9,982	14,098	1,248	15,346	—
July ...	536	1,058	616	1,298	5,703	9,211	1,259	11,550	1,080
1934, January ...	617	1,367	752	1,557	9,469	13,762	1,320	15,082	—
July ...	405	734	590	1,172	5,526	8,427	1,132	10,509	950
August ...	370	649	545	1,025	5,785	8,374	—	—	—
September	340	668	535	1,002	7,575	10,120	—	—	—
October ...	339	696	697	1,088	9,344	12,164	—	—	—
November	332	680	713	1,246	9,760	12,731	—	—	—
December	345	682	760	1,253	9,605	12,645	—	—	—
1935, January ...	397	640	768	1,149	8,930	11,884	1,060	12,944	—
February	363	619	739	1,117	8,338	11,176	—	—	—
March ...	341	567	647	1,074	7,751	10,380	—	—	—
April ...	323	548	595	1,020	7,168	9,654	—	—	—
May ...	276	510	510	938	6,526	8,760	—	—	—
June ...	267	493	445	843	6,045	8,093	—	—	—
July ...	201	395	315	749	5,708	7,368	1,030	9,078	680
August ...	180	342	238						

* Included in total.

WORLD'S CONSUMPTION OF COTTON.

(From the Statistics of the International Federation.)

(Running Bales, 000's—Excluding Linters.)

Variety.	*Season.*	*U.K.*	*Continent.*	*U.S.A.*	*Asia.*	*Others.*	*Totals.*
American.	1929–30	1,474	4,055	5,803	1,427	256	13,015
	1930–31	991	3,242	5,084	1,345	239	10,901
	1931–32	1,342	3,343	4,744	2,636	251	12,316
	1932–33	1,400	3,836	6,004	2,655	276	14,171
	1933–34	1,461	3,976	5,553	2,238	306	13,534
	1934–35	1,049	3,192	5,224	1,997	285	11,748
Indian.	1929–30	188	1,375	61	4,403	60	6,087
	1930–31	252	1,215	43	4,318	35	5,863
	1931–32	183	727	21	3,834	23	4,788
	1932–33	126	600	16	3,455	23	4,220
	1933-34	234	844	14	3,638	42	4,772
	1934–35	342	894	22	4,501	18	5,777
Egyptian.	1929–30	301	415	137	58	26	937
	1930–31	242	420	70	96	25	853
	1931–32	301	480	53	120	26	980
	1932–33	301	442	58	104	29	934
	1933–34	366	515	69	119	39	1,108
	1934–35	362	541	55	185	41	1,184
Sundries.	1929–30	502	2,044	51	1,825	740	5,162
	1930–31	479	1,984	42	1,648	711	4,864
	1931–32	560	1,730	26	1,133	786	4,235
	1932–33	421	1,797	32	1,922	856	5,028
	1933–34	409	2,137	33	2,154	964	5,697
	1934–35	754	2,594	19	2,456	1,152	6,975
All kinds.	1929–30	2,465	7,889	6,052	7,713	1,082	25,201
	1930–31	1,964	6,861	5,239	7,407	1,010	22,481
	1931–32	2,386	6,280	4,844	7,723	1,086	22,319
	1932–33	2,248	6,675	6,110	8,136	1,184	24,353
	1933–34	2,470	7,472	5,669	8,149	1,351	25,111
	1934–35	2,507	7,221	5,321	9,139	1,496	25,684

U.S. CONSUMPTION OF COTTON BY VARIETIES.

(Running Bales 000's: "Foreign" in Equivalent 500-lb. Bales.)

1933–34.	*Total.*	*Daily Rate.*	*Upland.*	*American Egyptian.*	*Egyptian.*	*Other Foreign.*	*Linters not Included.*
February ...	477·9	24·2	463·8	1·5	9·3	3·3	59·7
March ...	543·7	24·7	527·9	1·3	10·7	3·8	74·5
April ...	512·7	24·4	499·1	1·1	8·6	4·0	67·8
May ...	519·8	22·8	507·1	1·0	7·4	4·3	63·9
June ...	363·4	17·3	352·9	1·0	6·3	3·2	55·0
July ...	359·4	17·1	349·7	0·6	6·1	3·0	63·0
1934–35.							
August ...	420·9	18·3	409·4	0·8	7·8	2·9	61·2
September ...	296·0	15·0	289·3	0·3	4·5	1·9	54·7
October ...	520·3	22·9	506·6	0·9	10·4	2·5	57·4
November ...	477·1	22·2	465·1	0·8	8·5	2·7	51·4
December ...	413·5	21·8	403·5	0·8	6·8	2·5	52·1
January ...	546·8	24·0	534·3	0·9	8·7	2·9	61·8
February ...	478·3	24·2	467·1	0·7	7·3	3·1	62·8
March ...	481·1	22·9	469·6	0·8	6·9	3·8	66·8
April ...	462·8	21·3	450·8	1·1	6·8	4·1	70·3
May ...	469·2	20·6	458·8	1·4	5·7	3·4	65·5
June ...	385·9	19·3	376·8	1·3	4·6	3·2	61·9
July ...	391·8	17·8	382·0	1·3	4·7	3·8	62·1

HIGHEST AND LOWEST FUTURES PRICES.

1933–34.	American.				Egyptian (Liverpool).			
	New York.		Liverpool.		Sakel.		Uppers.	
	High.	Low.	High.	Low.	High.	Low.	High.	Low.
February	12·54	11·53	6·48	5·92	*9·25*	8·36	7·23	6·61
March ...	12·38	11·71	6·40	6·04	8·91	8·35	6·99	6·69
April ...	12·23	10·86	6·14	5·62	8·62	7·90	6·80	6·18
May ...	11·59	10·70	6·05	5·57	8·37	7·88	6·63	6·14
June ...	12·52	11·61	6·55	5·94	8·48	8·22	6·98	6·55
July ...	*13·35*	12·03	*6·97*	6·28	8·60	8·10	*7·31*	6·75
1934–35.								
August ...	*13·84*	12·97	*7·23*	6·77	8·71	8·29	7·54	7·19
September	13·43	12·35	7·00	6·57	8·65	7·87	7·59	7·02
October ...	12·53	11·96	6·70	6·43	8·21	7·65	7·19	6·74
November	12·66	12·02	6·80	6·45	*8·85*	7·99	7·58	6·97
December	12·72	12·44	6·89	6·64	8·79	8·46	7·64	7·38
January ...	12·75	12·27	6·94	6·75	8·72	8·51	*7·75*	7·56
February	12·73	12·26	6·88	6·68	8·58	8·36	7·58	7·38
March ...	12·49	*10·25*	6·97	5·95	8·61	7·69	7·65	6·70
April ...	11·90	10·83	6·54	5·97	8·16	7·86	7·34	6·87
May ...	12.19	10·95	6·56	6·29	8·16	7·86	7·47	7·16
June ...	11·58	10·56	6·17	*5·74*	7·91	*7·62*	7·03	*6·66*
July ...	11·80	11·30	6·28	6·12	7·89	7·67	7·10	6·97
1935-36.								
August ...	11·60	10·31	6·22	5·63	7·86	7·58	7·04	6·42

Maximum and minimum figures in each season are given in italics.

LIVERPOOL SPOT PRICES OF AMERICAN WITH OTHER VARIETIES AS PERCENTAGES (LAST FRIDAY OF EACH MONTH).

1933–34.	*American (Middling). Pence per Lb.*	*Indian No. 1 Fine Oomra.*	*West African (Middling).*	*Brazil Pernam (Fair).*	*East African (Good Fair).*	*Tanguis (Good).*	*Uppers (F.G.F.).*	*Sakel (F.G.F.).*
February	6·67	73·2	98·5	97·8	107·5	118·0	107·9	136·6
March ...	6·35	70·1	98·4	94·5	107·9	118·9	108·0	137·6
April ...	5·88	70·9	100·0	94·9	109·4	121·3	106·5	137·2
May ...	6·20	75·2	99·2	95·2	108·9	120·2	107·6	135·8
June ...	6·84	73·2	99·3	95·6	107·3	118·3	102·8	122·1
July ...	6·97	72·5	98·6	96·4	106·5	117·2	104·0	122·0
Season's average	6·02	75·1	99·5	98·8	110·8	121·4	110·3	133·7
1934–35.								
August ...	7·11	70·5	99·3	96·5	105·6	116·2	105·1	122·9
September	6·91	69·8	99·3	96·4	106·5	116·6	103·9	121·7
October ...	6·92	68·1	98·6	95·7	107·2	114·5	105·2	118·8
November	6·96	70·7	98·1	95·3	106·8	114·7	108·8	129·3
December	7·20	73·8	98·2	95·4	107·9	113·5	109·4	124·2
January ...	7·08	77·5	98·6	95·8	109·9	113·4	112·6	127·1
February	7·10	77·5	99·3	96·5	110·6	113·4	107·3	124·8
March ...	6·36	80·3	99·5	96·4	112·1	114·5	116·8	130·3
April ...	6·78	82·2	99·3	96·3	111·1	113·3	117·1	124·6
May ...	6·92	77·7	97·1	94·9	107·2	109·4	109·8	117·9
June ...	6·85	80·0	98·5	96·4	108·8	109·5	108·2*	117·2
July ...	6·80	81·8	100·0	96·3	106·6	108·8	108·5	118·7
Season's average	6·94	75·6	98·7	96·0	108·4	113·5	109·4	122·9
1935-36.								
August ...	6·21	76·0	100·0	95·2	106·4	108·9	114·2	128·0

* New Contract.

NOTES ON CURRENT LITERATURE

COTTON IN INDIA.

494. Indian Central Cotton Committee. We have received from the Publicity Officer a notice to the effect that at the thirty-first meeting, to be held on August 19 and 20, numerous questions of vital importance to the Indian cotton industry will be discussed, including the following: the formation of a compact block of long staple cotton in Sind; licensing of gins and presses; standardization of weights for cotton transactions; proposed additions and amendments to the bylaws of the East Indian Cotton Association Ltd., relating to cotton options and the schemes for the publication of cotton forecasts; broadcasting commercial news on cotton; railway freight rates on cotton; mixing of Punjab-American cotton; the progress made in connection with the various research and seed schemes. Proposals for the following new schemes will be discussed: The introduction and extension of B.D.8 cotton in the Broach district; the extension of cultivation of long-staple cotton in Bengal; revised seed schemes for the distribution and extension of Jayawant and Badag No. 1 cottons in the Southern division of the Bombay Presidency.

495. Indian Cotton Chart, 1934-35. We have received from Messrs. Chunilal, Mehta and Co., Bombay, a copy of their annual cotton chart, which is published for the eleventh year in succession. The chart is issued at the termination of the Broach contract for April-May delivery. The usual April-May Broach quotations in Bombay and corresponding contract quotations for American cotton in Liverpool and New York are given, together with the London-New York cross-rate. Figures are included for acreage, crop, and yield per acre for Indian and American cotton for the 1934-35 season, and also acreage, crop, and yield per acre figures for the Indian crop for the past ten years.

496. Report on the Staple Length of the Indian Cotton Crop of the 1934-35 Season. (*Stat. Leaflet No.* 1, 2nd issue, 1934-35, Ind. Cent. Cott. Comm.) The crop of 1934-35 is estimated to produce in bales of 400 lb.:

	Bales.
Long staple, over 1 inch	51,000
Medium staple, $\frac{7}{8}$ to 1 inch	1,142,000
Short staple, below $\frac{7}{8}$ inch	3,614,000
Grand total	4,807,000

497. Spinning Test Reports on Indian Cottons. By N. Ahmad. (*Ind. Cent. Cott. Comm. Tech. Circs.* Nos. 166, 168-173, 1935.) The circulars contain the grader's report and spinning test results for Hubli Kumpta cotton, and the reports of the Standards Committee and spinning test results for Latur, Nanded, Muttia, Broach, Jagadia, and Punjab-American cottons for the 1934-35 season.

498. Cotton Cultivation in Sind. By W. J. Jenkins. (*Karachi Cott. Ann.*, 1933-34, No. 1, p. 18.) The average area under cotton, prior to the Lloyd Barrage, was about 325,000 acres, while in 1934-35 that area was doubled. Development tends in the direction of producing finer types of cotton, American and Egyptian. A million acres under cotton is now looked upon as a possibility, and the breeding of improved varieties is an important item of work. A new and promising strain of Punjab-American, 289F-20, is being multiplied at Mirpurkhas. The Indian Central Cotton Committee finances a scheme for extending these improved

varieties, and much work is being done in carrying out varietal tests, multiplying and distributing seed, and the like. Consignments of improved seed, issued by the Agricultural Department, are accompanied by germination-test reports. Physiological research is also going on, especially in regard to the economics and technique of the use of irrigation water. The question of reserving an area for the cultivation of a compact block of long staple cotton is now under consideration by Government. The Sind Cotton Committee was established in 1931, and meets about twice a year; it deals with all the numerous and important matters connected with the cotton industry, and makes recommendations to Government.

COTTON IN THE EMPIRE (EXCLUDING INDIA).

499. The following reports have recently been received:
IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY: Ann. Rpt. to July 31, 1934.
FIJI: Ann. Rpt. of Dpt. of Agr., 1933.
NIGERIA: *Northern Provinces*, Ann. Rpt. for 1934.
NYASALAND: Ann. Rpt. of Dpt. of Agr., 1934.
SUDAN: Ann. Rpt. of Dpt. of Agr. and Forests, 1934.
,, Rpt. of Gezira Agr. Res. Serv., 1934.

500. COTTON-GROWING. By J. A. Todd. (*Times Trade and Eng.*, May, 1935, xxii.) An interesting survey of Empire cotton-growing during the past twenty-five years, and a discussion of the economic factors affecting production. In the concluding paragraph the author writes as follows with reference to the past season: "The most important development affecting Empire cotton has been the forced rise in the price of American cotton, due to inflation and to the drastic cut in the 1934 crop as the result of the American Government's restriction policy, and the coincidence of a severe drought in the West. The rising price of American has, of course, carried the world price with it, but all kinds of 'Outside Growths,' not only Empire, have lagged a little behind American in the rise, with the result that world consumption has been diverted to an extent never before equalled from American to Outside Growths, and all the Empire crops have benefited very greatly as the result."

501. THE EAST AFRICAN AGRICULTURAL JOURNAL. We extend a welcome to this new journal, a copy of the first number of which has just been received. The journal is issued under the authority of the East African Governors' Conference, and is published every other month commencing with January. The annual subscription is 5s.; single copies 1s., post free, obtainable from the Government Printer, P.O. Box 128, Nairobi. The Editor is Mr. W. Nowell, Director of the East African Agricultural Research Station, Amani, Tanganyika, and the Directors of Agriculture of Kenya, Tanganyika, Uganda, and Zanzibar constitute the Editorial Board.

The present number contains the following, among other articles: "The Inoculation of Leguminous Crops"; "Measures against Soil Erosion in Tanganyika"; "Cotton Selection and Rotation of Supply of Improved Cotton Seed"; "Notes on Cotton Breeding in Uganda"; "Tea Cultivation in the Southern Highlands of Tanganyika"; "The Climate and Weather of East and Central Africa," etc.

The journal should make a wide appeal to those whose livelihood is farming and whose well-being depends on agriculture, and it should also serve a useful purpose in strengthening the ties between agricultural communities who have common interests in neighbouring territories. We wish it every success.

502. BASUTOLAND: FINANCIAL AND ECONOMIC POSITION. (Cmd. 4907. Pubd. by H.M. Stat. Office, 1935, price 3s. 6d. net.) We have received a copy of the report of the Commission appointed by the Secretary of State for Dominion Affairs in January, 1935, "to inquire into the position of Basutoland from the financial and economic points of view, and to report thereon." The Commissioner, Sir Alan Pim, was accompanied by Mr. S. Milligan, the senior representative in South Africa of the Empire Cotton Growing Corporation.

The various chapters of the report are headed: General Description; Political History; Economic History; Present Position and the System of Government; Financial History, and Income and Expenditure; Possibilities of Development. The proposals for development are mainly the work of Mr. Milligan. Various appendices are included dealing with Rainfall, Imports, Exports, Revenue, Expenditure, etc.

503. NIGERIA: *Cotton Cultivation*, 1934-35. (*Half-yearly Rpt. of Dpt. of Agr. to March* 31, 1935.) *Northern Provinces.*—The purchases of American cotton for export were the highest on record, being some 35 per cent. greater than in the previous best year (1925-26). The estimate of 49,444 bales is based on an assumed ginning outturn of 30 per cent., but as this figure is more likely to be too low than too high, it is probable that the actual final total, which only becomes available when ginning has been completed, will exceed 50,000 bales. In the opinion of most Agricultural Officers, the year's big crop was due not only to the quantity of seed sown, but also to more timely sowing and improved cultivation of the fields. This is a hopeful sign, since it shows that in Zaria, Katsina, and Eastern Sokoto farmers now regard cotton as the most important crop on the farm. There is every reason to believe that the year's increase represents permanent progress, and is not merely an exceptional occurrence, although occasional setbacks will no doubt be experienced when the price of cotton falls, or when the weather is unfavourable. As in the previous season, the crop contained a good deal of immature cotton, and also more stained cotton than usual. The class of cotton of Northern Nigeria is still relatively high as compared with that of many cotton-growing countries, but it is also distinctly lower than it was a few years ago. It is evident that a reform of the marketing system is essential, and exporters have signified their willingness to co-operate with the Agricultural Department in effecting such a reform. A Committee has been appointed to make recommendations on the subject, and as a result regulations have been framed which it is hoped will be in force next season and will lead to an improvement in the class of cotton exported.

Higher prices were obtained for the crop than in recent years, and the producer received a good return for his cotton.

There has been a keen demand for seed for planting in 1935, and the total distribution is expected to exceed that of 1934 by 1,000 tons.

Southern Provinces.—The purchase of seed cotton for export in the 1934-35 season totalled 4,200 bales of 400 lb. as compared with 3,000 bales in the previous season. The bulk of the crop was again Grade III., the percentages of Grade I. and Grade II. in the Improved Ishan being less than those of last year.

504. NORTHERN PROVINCES: *Cotton Cultivation*, 1933-34. (*Ann. Rpt. N. Provs.*, 1934.) The extent to which farmers favoured cotton in preference to groundnuts cannot be estimated closely, as a considerable amount of cotton seed was planted in areas where formerly little cotton or groundnuts were grown. The price of cotton was but a little higher than the previous year, but the crop was in most places good, and the comparative stability of the price as compared with that for groundnuts is a factor favourable to cotton.

Animal husbandry or "mixed farming" made good progress, and confidence is felt that it is now established firmly.

In connection with transport, new roads have been made and existing roads extended. The work of maintenance steadily increases, but has been carried out with little additional cost. The steady fall in motor transport costs reflects the improvement which has been effected.

505. *Cotton Investigations.* (*Bull. Imp. Inst.*, **32**, 3, 1934, p. 459, and **33**, 1, 1935, p. 75.) From the report of the Agricultural Botanist, Northern Provinces, we learn that as the result of selection work with Allen cotton carried out in 1933-34, two strains, D.31 and C.31, were thought worth sending for a spinning test and broker's report. The strain E.31 was excluded because of a great deal of "silvery lint" and immature seeds, characters which have come to be associated with "nep" and high percentages of dead hairs. The broker's report was unfavourable to the promising strain D.31, classing it as shorter and weaker than ordinary ginnery cotton (B.C.G.A.), and worth 6·66d. per lb. as compared with 7·01d. with American futures at 6·26d. This strain is as yet far from pure, so that it still has possibilities.

The spinning test report of the Shirley Institute on the two new strains confirmed the broker's report as regards the inferiority of D.31 to ordinary Allen, but did not show that C.31 was very much better than Allen, though its "staple" was longer. The two strains, together with E.31 (which was not sent to England for report), are, nevertheless, considered to have certain agricultural merits. C.31 and E.31 are highly resistant to jassid, and D.31 and E.31 are also highly resistant to leaf curl, as the following figures show:

BOMO YIELD TRIAL (16 PLOTS OF ORDINARY ALLEN, 5 PLOTS OF EACH VARIETY).

Variety.	*Per Plot.*	*Average Number of Plants Damaged by Leaf Curl.*	*Per cent. Leaf Curl.*
Allen	937	133	14·2
Kl	953	95	10·0
L	858	167	19·5
D.31	927	17	1·8

SAMARU SMALL-SCALE YIELD TRIAL (9 PLOTS OF EACH VARIETY).

Variety.	*Total Number of Plants.*	*Total Number of Plants Damaged by Leaf Curl.*	*Per cent. Leaf Curl.*
Allen	776	113	14·6
Kl	779	98	12·6
L	775	205	26·4
S.G.27	779	146	18·7
C.31	775	109	14·1
D.31	776	45	5·8
E.31	772	16	2·1

None of the sixteen plants of E.31 was seriously damaged by the disease, and this strain may be considered to be almost immune. Strain L is obviously more susceptible than Allen, and so is S.G.27 (introduced from Uganda), but the significance has yet to be worked out. As might be expected, these two strains

produce lint of higher quality than the others. Strain L is potentially a high-yielding type which is reduced to the level of Allen, or lower, by its susceptibility to leaf curl and jassid.

506. NYASALAND: *Cotton Cultivation*, 1934. (*Ann. Rpt. Dpt. of Agr.*, 1934.) The production of native-grown seed cotton amounted to 5,377 tons, compared with 3,079 tons in 1933. European production amounted to 368 tons, compared with 102 tons the previous year, which argues an increased interest in the crop. Climatic conditions were in general good, and the season was marked by the interest of new buyers, a fair average yield per acre, and improved prices to growers. The total sum paid to growers was £56,374. The proportion of No. 1 grade was smaller than usual, and special attention will be given to marketing and grading in 1935. The Cotton Ordinance passed in 1934 regulates and controls the industry. Appreciation is expressed of the work that is being done for the industry by the Empire Cotton Growing Corporation.

At the Corporation's Experiment Station at Domira Bay, spacing, intercropping, varietal trials, and strain tests were continued. The average yield was 260 lb. lint per acre, an increase of 10 lb. over last year, thus proving the suitability of the area for cotton. An effective system of storm drainage has been completed at the Station, any fields with a pronounced slope have been contour drained, and it is confidently expected that there will be no trouble from erosion.

The main pests encountered in 1934 were locusts and stainers, but the damage caused was not so severe as in the previous year.

507. *Cotton Cultivation*, 1934-35. A report from H.M. Eastern African Dependencies' Trade and Information Office for the month of May states that "In Lower River areas a fair amount of cotton has broken, and picking is becoming general. The low percentage of stained and soiled cotton obtained from this early picking is a satisfactory feature. Insect pests show normal infestation. A preliminary estimate of seed cotton in the Lower River areas is 16,000,000 lb. produced by 31,956 growers.

"The first flush has been harvested in the Dedza and Dowa littorals. Cotton planted in December and January has a fairly high proportion of low-grade lint, but later plantings promise a high percentage of No. 1 grade. Staple is of good length and relatively strong. Cotton in Kota Kota is later, but is very good. Harvesting is also proceeding in other central areas, but in Southern Ncheu and the higher parts of Zomba, Chiradzulu, etc., above 2,500 feet elevation, the crop, through the operation of various factors, is rather disappointing."

508. *Cotton Industry*, 1934-35. (*Mnthly. Trade Cables and Rpts. from Branches*, Barclays Bank, Ltd., June, 1935.) The cotton crop is reported to be good; it is estimated that exports will total 18,000 to 20,000 bales, compared with just over 10,000 bales last year.

509. THE SUDAN, 1935. By Sir William Himbury. (*British Cotton Growing Association*, 1935, price 1s.) An interesting account of a visit to the Sudan and Egypt. One of the objects of the journey was to enquire into storage facilities at Port Sudan, and these were considered adequate. Sir William Himbury states that the present cotton crop of the Sudan is good both as regards quantity and quality, and he is satisfied that the country will continue to produce large quantities of excellent cotton. Several illustrations are included in the report.

510. *Cotton Cultivation*, 1933-34. (*Ann. Rpt. of Dpt. of Agr. and Forests*, 1934.) From this report we learn that the 1933-34 cotton crop of the Gezira Irrigation Scheme was put in under favourable conditions, and there was promise of a

good crop. Unfortunately exceptionally heavy rainfall was experienced, and blackarm spread over large areas. Leaf curl also appeared, but caused little damage. The extraction of the old cotton plants by the roots, and the rigorous suppression of accidental ratoon plants, afforded an effective control of leaf curl in the Gezira. The yield per feddan averaged 2·34 kantars, comparing unfavourably with a 3·60 average of twenty-three years. There was a good proportion of high-grade cotton, and the behaviour of certain selected strains was very gratifying. The most promising of these, a direct selection of Gezira-grown Sakel which had been under observation for several years, was propagated on an area of 773 feddans in scattered blocks. It was severely attacked by blackarm, but made a wonderful recovery and yielded 4·4 kantars per feddan.

The 1934-35 crop made a good start, and promises to give a more than average yield with a high-grade cotton usually associated with early picking.

The flood crop grown on the delta of the Gash at Kassala was very successful in 1933-34, the yield and quality of the cotton being exceptionally high. Leaf curl caused considerable injury to the Tokar cotton crop. The rain-grown cotton industry of the South is considered to be well established and capable of great expansion.

The number of ginneries in operation during the season was twenty-one. Three new ginneries are under construction; they will be equipped with saw gins, and burn suction gas produced from cotton seed.

The usual detailed appendices of sections of the work are included in the report.

511. Report of the Gezira Agricultural Research Service, 1934. The third report contains, in addition to the introductory note by the Controller, reports on the experimental work carried out during the 1933-34 season by the Agricultural, Plant Observation, Plant Physiology, Chemical, Entomological, Botanical, Plant Pathology, and Plant Breeding Sections, and a note on "Outstations" experiments.

From the note of the Controller we learn that the cotton crop was again disappointing owing to the heavy and prolonged rainfall in October and November, and the average yield was only slightly over 2¼ kantars per feddan. Blackarm and leaf curl were not responsible for serious injury to the crop, but considerable losses were caused by white ants and American bollworm. Measures of control are under investigation by the Entomological Section.

The comparative failure of ordinary Sakel during the season served to throw into relief the progress made in evolving new strains capable of withstanding the effects of unfavourable conditions in the Gezira. Details are given of the yields obtained from some of these varieties, notably "X1530," a direct selection from Sakel. The lint is slightly coarser than Sakel, but the strain is highly resistant to leaf curl. Another variety, X04729, shows great promise as regards yielding power, but is as yet not so resistant to leaf curl as X1530. Selection work is being continued.

Further progress was made towards the solution of the fundamental problem of the cause or causes of the wide seasonal fluctuations in yield which occur in the Gezira.

A study of the effect of fallowing on plots which had been under "continuous" cotton for some years indicated that a single year's fallow break produced an increase in yield of cotton of 35 per cent., whereas a second year's fallowing gave practically no further increase. A lubia crop taking the place of a single cotton crop in the "continuous" series produced increases of about 70 per cent. in the yield of the cotton crop which followed. Two years' lubia gave better results than one.

The results of two field experiments on the spread and control of blackarm indicated (1) that dust composed of fragments of heavily diseased leaves falling on the ground cannot survive the natural weathering to which it is subjected there, and is incapable of infecting a crop of cotton subsequently sown on it; (2) that flooding is effective in reducing or even destroying the infectious nature of larger fragments of infected debris from a preceding cotton crop.

Considerable progress was made in obtaining strains of American cotton suitable for areas outside the Gezira Scheme. The new strain, "XA1129," gave excellent yields, and was well reported on by the staff of the Shirley Institute. Another strain, "513," also gave excellent yields, and in addition was early maturing and highly resistant both to leaf curl and to jassid attack.

512. TANGANYIKA: *Cotton Industry.* (*Trop. Life*, June, 1935, p. 114.) As a result of the campaign to plant more cotton in Tanganyika, a largely increased acreage has been put down to this crop. The fact that the country produces the finest rain-grown cotton in the Empire ensures the future of the crop, but the scattered and backward population and lack of communications hinder development. The zoning of ginneries is a very practical help towards the establishment of a healthy industry, and must tend to make each ginnery take a personal interest in its zone; and consequently not only the amount but the quality of the lint will be improved. In addition, co-operation between Government, ginners and growers, which is essential to real success, is being stimulated.

513. UGANDA: *Cotton Industry*, 1934-35. (*Monthly Trade Cables and Rpts. from Branches*, Barclays Bank, Ltd., June, 1935.) "The weather has been cool and exceptionally wet for the time of year. Cotton purchases to the end of April totalled 245,862 bales, so that the original official estimate of 240,000 bales has already been exceeded; prices are steady."

514. *Cotton Cultivation*, 1935-36. The latest report from the Department o Agriculture states that a rainfall considerably above normal in most areas, together with subnormal temperatures, has retarded actual planting, although preparation of plots is well forward. It may be expected that, given normal weather conditions from now onwards, the satisfactory soil saturation prior to planting should have a favourable effect on the subsequent crop yield.

515. AUSTRALASIA. THE AUSTRALIAN RAW COTTON BOUNTY ACT, 1934. (*Text. Wkly.*, xv., **373**, 1935, p. 455.) A discussion of the provisions of the Cotton Bounty Law passed by the Australian Parliament in August, 1934. The main objective of the law is "to expand and at the same time regulate cotton production in Australia, so that domestic growers will produce only enough to supply the estimated requirements of local spinners, plus an additional 20 per cent. to be used for other purposes."

516. QUEENSLAND: *Cotton Prospects*, 1934-35. (*Queensland Agr. Jour.*, lxiii., **5**, 1935, p. 490.) Dry and rather warm weather was experienced throughout the main cotton-growing districts from February to April. These conditions greatly curtailed the crop prospects which appeared likely to be realized at the end of January. The plants were then generally so very heavily laden that good rainfall was required for the rest of the season to develop the crop. The dry conditions which prevailed, however, caused a general loss of top crop and hastened the maturing of the bolls developed. The average yield per acre is expected to be lower than that of the previous season, the difference being made up by the larger area planted.

The seasonal conditions have again demonstrated the important part cotton should play in the cropping system of most of the agricultural districts away from the immediate coastal regions. In most of these areas, particularly in the

Burnett and Central Districts, all fodder and grain crops have suffered very severely from the adverse conditions, while cotton crops, although checked, have yielded well enough generally to produce returns covering the costs of production, or better. With one soaking rain at mid-January the average cotton yields would have been appreciably increased, while only moderate improvement would have been effected in other crops.

517. *Classing Queensland Cotton.* By R. W. Peters. (*Queensland Agr. Jour.*, xliii., **5**, 1935, p. 483.) A brief outline is given of the development of cotton grading and of the establishment of the World's Universal Cotton Standards by the U.S. Department of Agriculture. These Standards are the basis for classing Queensland cotton, but it has been found necessary to deviate from them somewhat on account of the tendency for the Queensland crop to contain more "spot" in the white grades than is allowed by the Universal Standards. The various factors which must be taken into consideration when grading or valuing cotton are colour, the amount and nature of foreign matter contained in the sample, the condition of the cotton after ginning, the strength, body, drag or twist of the fibres, the degree of neppiness, and the staple length of the cotton. In conclusion, the author points out to cultivators the necessity for careful harvesting, grading, and packing of their cotton in order that it may compete profitably on the world's market.

518. *Snapping Cotton.* By W. G. Wells. (*Queensland Agr. Jour.*, xliii., **5**, 1935, p. 479.) Snapping is now being practised in Queensland, and appears very suitable for dry seasons. The paper contains recommendations as to the varieties suitable for snapping and the correct time for snapping the crop.

519. FIJI: *Cotton Cultivation,* 1933. (*Ann. Rpt. Dpt. of Agr.*, 1933, recently received.) "Owing to the large carry-over of cotton in America and elsewhere and the low prices ruling, it was decided that a large area should not be planted in cotton during the year, but sufficient seed was disposed of to provide supplies for planting in 1934 should conditions improve.

"The breeding work on the new Back Cross variety was continued at the Experimental Station at Sigatoka, and quantities of seed were issued for planting on a commercial scale. Seven bales of the Back Cross composed of several types were shipped to the British Cotton Growing Association in December with a view to having large-scale spinning tests made."

520. WEST INDIES. ANTIGUA'S COTTON INDUSTRY. By F. H. S. Warneford. (*W. Ind. Comm. Circ.*, l., **958**, 1935, p. 248.) The low prices ruling in recent years resulted in a decrease in the area planted to cotton from 1,500 acres in 1930-31 to 65 acres in 1933-34. During this period the industry was kept alive mainly by peasant growers. Cotton is an ideal crop for peasants in the dry east and north-east portions of the island, but the lands are frequently situated some distance from the railway. Were market conditions really satisfactory there could be a very considerable production of cotton in this district. A definite improvement in the quality of Antigua cotton has resulted in recent years through the importation of a small quantity of pedigree seed from Montserrat, and subsequent multiplication of this seed under the supervision of the inspector. In view of the slight improvement in the cotton situation in the past few months, permission has been granted to extend the area planted for the 1935-36 crop to 600 acres.

521. TRINIDAD: *Reportaje Sobre la Estacion Experimental Algodonera de la Isla de Trinidad.* By R. Arango. (*Rev. Agr.*, 15, Habana, 1935, p. 31. From *Pl. Bre. Absts.*, v., **4**, 1935, p. 341.) An account of a visit to the Cotton Research Station, Trinidad, and descriptions of the genetical research in progress.

COTTON IN EGYPT.

522. ABOLITION OF THE COTTON TAX. (*Int. Cott. Bull.*, xiii., **51**, 1935, p. 346.) Towards the end of March the Council of Ministers approved in principle the abolition of the remaining half of the cotton tax. It was imposed at the rate of P.T.35 per kantar, on April 18, 1920. Cotton was then fetching enormous prices, and farmers refused to grow relatively unprofitable cereals where cotton could be planted. In consequence, there was a serious shortage of foodstuffs in the country, and it was very difficult to get supplies from abroad. The Government had to step in and purchase cargoes of wheat, maize, rice and flour, which were sold to merchants at reasonable prices, in an effort to keep down the cost of living. To meet part of the loss on these transactions the cotton tax was imposed. The tax was reduced to P.T.25, and in 1928 to P.T.20. Then, in 1931, after a great deal of agitation, the Sidky Government reduced it to P.T.10, and to compensate the Treasury for this loss an increase was made in the stamp duty on officials' salaries. His Excellency Ahmed Abdul Wahab Pasha, the Minister for Finance, in his note to Council, stated that the total proceeds of this tax from 1920 to 1933 amounted to £E.19,750,000, plus £E.800,000, being the estimated proceeds for the year 1934-35. The note further suggested that the abolition of the tax should be effected as from the beginning of the present financial year—*i.e.*, May 1, 1935—provided that the Ministry took the necessary steps to find other sources of revenue to produce the same amount as that produced by the cotton tax.

The removal of the tax should permit a slightly lower level of prices for Egyptian cotton without in any way affecting the remunerativeness to the grower, and this should be an advantage to Egypt in the long run.

523. LANCASHIRE AND EGYPTIAN COTTON. By J. A. Todd. (*Near East and India*, May 2, 1935, p. 549.) The consumption of Egyptian cotton, both in Lancashire and elsewhere, appears to be determined chiefly by its relative prices. "The best thing that Egypt can do, therefore, to increase Lancashire's consumption of Egyptian cotton, is to maintain her recent policy of keeping the price of Egyptian, especially Uppers, as reasonable as possible; and with the artificially high price which America has forced on the world during the last year or more, it should not be difficult for Egypt to maintain her favourable position."

524. EGYPTIAN COTTON SPINNING TESTS. By H. A. Hancock. (*Text. Wkly.*, xv., **375**, 1935, p. 505.) A description of the Giza Testing Laboratory and of the spinning technique employed.

525. EGYPTIAN COTTON VARIETIES: THE SAKEL CONTRACT. By C. H. Brown. (*Man. Guar. Coml.*, 17/5/35.) Until recently the bulk of Egyptian cotton has been divided into long and short staple types—Sakel and Uppers—for which two distinct futures contracts exist both in Alexandria and in Liverpool. The position is now becoming more complex with the increasing growth of new strains of different staple type, such as Giza 7, Maarad, Sakha 4, Giza 12, and a new Sudan strain X1530 (known in Lancashire as "L"). Giza 7 is increasing at the expense of Sakel, which is also likely to lose still further ground to Sakha 4 and Maarad, so that Giza 7 will soon be the predominating staple of cotton grown in Egypt. The only satisfactory solution on the contract market seems to be the changing of the Sakel contract into a general long staple contract, with spot differences adjusted from time to time in accordance with the existing parities of the different growths.

COTTON IN THE UNITED STATES.

526. THE EFFECT OF THE NEW DEAL ON THE U.S. COTTON TEXTILE INDUSTRY. By H. O. Chalkley. (*Int. Cott. Bull.*, xiii., **51,** 1935, p. 389.) The position of the cotton manufacturing industry as a whole appeared somewhat better at the end of 1934, though exports had fallen heavily, and mill consumption of cotton for the year up to the end of October was about one-sixth less than in 1933.

527. EVALUATING THE COTTON PROGRAMME. By — Cox. (*Int. Cott. Bull.*, xiii., **51,** 1935, p. 322.) A rather gloomy account of the working of the Federal Government's cotton programme during the past two years, in which the author calls attention to the fact that the gold price of cotton has risen but slightly.

528. AMERICAN COTTON: ONE-VARIETY PRODUCTION. By A. B. Bryan. (*Cotton,* U.S., xcix., **3,** 1935, p. 48. From *Summ. of Curr. Lit.*, xv., **11,** 1935, p. 267.) The advantages of co-operation among farmers to undertake one-variety cotton production are discussed. Concrete examples are given of the contrasts between one-variety co-operation, and uncontrolled multiple-variety production in which "run-down" short staple varieties are included.

529. ARKANSAS: *Cotton Experiments,* 1933-34. (*Forty-sixth Ann. Rpt. Agr. Exp. Sta. Arkansas,* 1934.) Describes varietal, breeding, spacing, and fertilizer experiments, cotton fibre investigations, and experiments to determine the relation of earliness of cotton to boll weevil injury. In the cotton varietal studies, the best long staple varieties were Missdel 2, 3, 4 and 5, Delfos 531 and 719, and Arkansas 17, but with the exception of the last all were highly susceptible to cotton wilt. Of the intermediate staple group, the Rowden strains were the most successful. They had the required staple length, wilt resistance, large bolls, storm resistance, ability to yield well, and excellent character of lint.

530. FLORIDA: *Experiments with Field Crops.* (*Florida Sta. Rpt.*, 1933. From *Exp. Sta. Rec.*, 72, **3,** 1935, p. 316.) Included the following in connection with cotton: breeding experiments, varietal trials, and fertilizer and cultural experiments.

531. SEA ISLAND COTTON. (*Int. Cott. Bull.*, xiii., **51,** 1935, p. 329.) Several hundred acres of Sea Island cotton will be planted in Florida this year under the supervision of experts in weevil control, and satisfactory yields are expected. Sea Island cotton is not under the acreage control laws, and farmers are therefore more interested in making an effort to re-establish this once profitable crop. Only 20 bales of this cotton were produced in the United States in 1934, but an increase to more than 100 bales is expected in 1935. The 1934 crop sold at an average price of 28 cents per lb., which compared with approximately 12 cents per lb. for Upland cotton.

532. NEW MEXICO: *Quality of Cotton Produced in* 1928-32. By J. R. Kennedy and J. C. Overpeck. (*New Mexico Sta. Bull.* 225, 1934. From *Exp. Sta. Rec.*, 72, **3,** 1935, p. 408.) A study made in co-operation with the Bureau of Agricultural Economics, U.S.D.A. Cotton represented about 42 per cent. of the total cash income from all farm crops in New Mexico for the five-year period 1928-32. Of the cotton ginned in the State during the period 56 per cent. classed as Strict Middling and above, and 83 per cent. of the staple was 1 inch and longer, as compared with 39 and 24 per cent. respectively for the United States. Practically all of the New Mexico cotton ginned $1\frac{1}{16}$ inch and longer-graded Middling or above, and more than 90 per cent. of New Mexico cotton was tenderable on future contracts. Grades averaged slightly higher, and staple almost $\frac{1}{16}$ inch longer in the Mesilla Valley than in the Pecos Valley. The average staple length

of $1\frac{1}{32}$ inch for the State was made possible by the production and distribution of seed of one variety, Acala.

533. *Acala Cotton Production.* By A. R. Leding. (*U.S. Dpt. Agr. Circ. No.* 314, 1934. From *Summ. of Curr. Lit.*, xv., **10**, 1935, p. 241.) The cultural and economic advantages of "community" production are described with reference to the cultivation of Acala cotton in several counties of New Mexico.

534. OKLAHOMA: *The Sale of Cotton in the Seed.* By L. S. Ellis *et al.* (*Oklahoma Sta. Bull.* 219, 1934. From *Exp. Sta. Rec.*, 72, **4**, 1935, p. 553). This study, carried on in co-operation with the Bureau of Agricultural Economics, U.S.D.A., was made: (1) to determine the extent and distribution of the practice of selling cotton in the seed in Oklahoma, and to determine whether or not the practice is increasing or decreasing; (2) to measure the differences between the prices received by farmers in their local markets for cotton sold in the seed and in the lint bale; (3) to measure the differences between the prices received by farmers for both seed and lint cotton in their local markets, and the prices paid for the same grades and staples of cotton in the central market; (4) to analyze the variation in grade, staple length, and turn-out of individual loads of seed cotton sold at the same price; (5) to call attention to some of the factors responsible for, or associated with, the development of the practice; and (6) to point out the economic effects on farmers, middlemen, and spinners of the practice of selling cotton in the seed.

535. *Current Farm Economics.* (*Oklahoma Sta. Circ. Ser.* 49, vol. viii., **2**, April, 1935.) A useful publication. A striking graph of the gradual progress of American cotton and outside growths is given on the front page. The latter followed the former upward in a general way till the last few years, when it showed a marked rise corresponding to a fall in American.

536. TENNESSEE: *Farm Price of Cotton in Relation to Quality: A Progress Report.* By C. E. Allred *et al.* (*Tennessee Sta. Bull.* 153, 1934. From *Exp. Sta. Rec.*, 72, **3**, 1935, p. 407.) The work is based on a very large number of purchases and sales of single bales. Detailed figures are given, and go to show that the grower actually received 90 per cent. or over of the better prices obtained for the better grades.

COTTON IN FOREIGN COUNTRIES.

537. THE WORLD COTTON SITUATION: FOREIGN COTTON PRODUCTION. (*U.S. Dpt. Agr. Bur. of Agr. Econ.*, Washington, D.C., April, 1935.) A detailed and useful account of cotton cultivation in all the different producing countries, with historical background, and numerous graphs and tables of production, and a discussion of future prospects of the industry in each country.

In the study attempts have been made to answer such questions as: What are the most important factors in determining production in the more important producing countries? What appears to be the trend in the production of foreign cottons, as to quantity and quality? What are the possibilities as to expansion of production and improving quality? What are the probable developments in production in the next year or two? How do changes in the price level of cotton affect foreign production?

538. ARGENTINA: *Cotton Cultivation.* (*Int. Cott. Bull.*, xiii., **51**, 1935, p. 295.) The estimated area planted to cotton in the 1934-35 season ranges from 495,000 to 556,000 acres. Cotton growing is mainly confined to the Chaco in the north-eastern part of the country, where some 2,000,000 acres are still available. A considerable increase in population and better facilities for ginning and handling the crop will be necessary, however, before this acreage can be planted to cotton.

539. *Cotton Industry*, 1934-35. (*S. Amer. Jour.*, 20/7/35.) Good rainfall conditions were experienced at planting, and it is estimated that the area under cultivation in the Republic shows an increase of 15 to 20 per cent. over that of last year. A crop of 250,000 bales is anticipated.

540. Belgian Congo: *Comment les Indigènes du Congo-Belge sont arrivés à produire Annuellement* 20,000 *Tonnes de Coton-Fibre.* By E. Leplae. (*Coton et Cult. Cotonn.*, ix., **3**, 1934, p. 169.) Obligatory culture by natives of small areas of cotton is a great factor in the result. The cultivator sells the cotton for his own profit, to his local ginnery, at a price fixed by the Government.

541. Brazil: *Cotton Production.* By M. Biehl. (*Wirtschaftsdienst*, **20**, 1935, p. 635. From *Summ. of Curr. Lit.*, xv., **12**, 1935, p. 300.) In 1932-33 Brazil produced about 1,000,000 bales of cotton which was used almost entirely by the home industry, but in 1934-35 the crop was practically doubled, and about half became available for export. Further developments are anticipated, and the State is supervising seed distribution, standardization, etc.

542. *Cotton Cultivation*, 1934-35. Information received from the Department of Overseas Trade is to the effect that the production of cotton for the current season is estimated at 370,500,000 kilos as against 279,700,000 kilos in the previous season. Every State, with the exception of Parana and Sergipe, has increased its production since last year.

543. *Cotton Production in Southern Brazil.* By P. K. Norris. (*U.S. Dept. Agr. Bur. of Agr. Econ., For. Agr. Service*, Washington, D.C., May, 1935.) Cotton in Brazil has gone through many vicissitudes, and is now once more on the up-grade. The present report deals with Southern Brazil, where American Upland cotton is grown upon the plateau behind the coastal mountains. The climate is favourable to cotton, and the State of São Paulo, the most important portion, never has killing frosts. Planting is from September to November, and harvest from March to May. The present population of this part of the country is about 20,000,000, mainly Portuguese and Italian stock in the north, German further south, while the Japanese are coming in and settling in large numbers, and produce much of the cotton. Transport is good on the whole, and there are large and important ports at Santos, Rio, etc. Ginning facilities are insufficient for the rapidly increasing crops, and are being extended. The yield of cotton is about 180 lb. per acre, but with a downward tendency, the growers in periods of depression giving less attention to cotton than to other crops. Fertilizers are little used. Pink bollworm is the most important pest. The quality of the crop is being improved, and the average staple of the São Paulo crop is now over 1 inch, while improved local varieties are being turned out by the Experiment Station.

The textile industry in Brazil is important, producing about 95 per cent. of the country's needs, the only imports being of high count goods. About 10 to 15 per cent. of the crop is exported, mainly to Europe. The production of more cotton for export is hindered by lack of capital, and also lack of labour, while at times coffee is more attractive than cotton.

Those interested in cotton cultivation in Brazil will find this paper of use.

544. The Industrial System: Its Evolution in the Far East. By A. F. Barker, of Chiao-Tung University. (*Text. Rec.*, liii., **627**, 1935, p. 42.) Discusses the development of the cotton and woollen industries of Japan and China.

545. China. *Cotton Production.* (*Cotton M/c*, 13/7/35.) The Chinese Cotton Statistics Association places the final 1934 cotton crop at 3,125,000 bales, against 2,726,000 in 1933. The 1935 crop is expected to be smaller than 1934, with

North China estimated at 80 per cent. of the 1934 harvest, while long staple cotton competing with American may show a greater reduction. The Yangtze Valley, which turned out 1,231,000 bales last year, is expected to produce more this year.

546. CHINESE COTTON INDUSTRY: OUTPUT, 1934. (*Text. Merc.*, **92**, 1935, p. 352. From *Summ. of Curr. Lit.*, xv., **9**, 1935, p. 240.) Lack of capital, poor prices for manufactured goods, and the relatively high price of raw cotton, are factors responsible for the unsatisfactory condition of the cotton industry in China. Spindleage has, however, increased in 1934, but the rate of increase of the foreign-owned spindles (chiefly Japanese) has been much higher than that of the Chinese. Yarn production has actually decreased, although the annual output of cotton piece-goods has risen, due to the activity of the Japanese-owned mills. The final result of the increased spindleage is that the production of cotton goods has exceeded the demand. Spindleage and cotton yarn and piece-goods production tables are given.

547. COTTON SPINNING AND WEAVING MILLS. (*Int. Cott. Bull.*, xiii., **51**, 1935, p. 394.) Two new Japanese-owned cotton-spinning and weaving mills in China are in course of construction in Tsingtao, Shantung Province. The larger mill will have more than 40,000 spindles and 720 looms, while the smaller will start with 35,000 spindles and 450 looms.

548. L'ASSOCIATION COTONNIÈRE COLONIALE ET LA PRODUCTION DU COTON DANS LES COLONIES FRANÇAISES. By F. Lavit. (*Coton et Cult. Cotonn.*, ix., **3**, 1934, p. 139.) An interesting account of the work that has been accomplished by the Association Cotonnière Coloniale, which was founded in 1903 by members of the Syndicat Général de l'Industrie Cotonnière Française to develop cotton production in the French colonies. The extension of the work is handicapped by lack of funds.

549. ITALY: WORK OF THE COTTON INSTITUTE. (*Text. Wkly.*, **15**, 374, 1935, p. 478.) The Institute is responsible for the supervision of the import and export trade in cotton and cotton goods. A levy of 30 centesimi per kg. (recently raised to 50 centesimi) is collected on imported raw cotton. The income from this source in 1934 amounted to about 56,000,000 lire. A small part of this money was allocated to research into the cottonization of hemp, and a product called "Sodolin" was evolved which has met with some success for bed linen, summer dress materials, etc. The chief object of the fund is to subsidize exports of cotton goods, and on the basis of last year's receipts it should be possible to grant subsidies up to 10 per cent.

550. JAPAN EXPORT INDUSTRIES: ECONOMIC CONDITIONS. (*Board of Trade Jour.*, **134**, 1935, p. 879. From *Summ. of Curr. Lit.*, xv., **12**, 1935, p. 324.) A policy of State expenditure financed by State borrowing has on the whole justified itself in Japan. During a period of world depression, production has shown a remarkable increase, export trade has flourished, and prices have remained fairly steady, whilst unemployment has been relatively low. It is, however, true that this prosperity in Japan has so far benefited only limited sections of the population; the agrarian class has had no share in it. Further expansion of export trade is planned, but restrictive action is being taken against Japanese trade in many countries, so that it seems unlikely that 1935 will show any pronounced increase in export figures.

551. CONSUMPTION OF AMERICAN AND OTHER GROWTHS OF COTTON IN JAPAN. By F. Taylor and R. Whitaker. (*U.S. Dpt. Agr. Bur. of Agr. Econ.*, Washington, D.C., June, 1935.) A detailed consideration of the subject, with graphs and tables. It is stated that the principal factors accounting for the marked increase

in the exports of Japanese cotton piece-goods during the period following the World War were: comparatively low wages in cotton textile industries; adequately financed cotton mills; and the aggressive and effective merchandising of cotton cloth in foreign markets.

552. POLAND. *Cotton Industry.* (*Trop. Life*, June, 1935, p. 119.) Polish cotton interests are stated to have acquired from the Liberian Government a concession of fifty cotton plantations, and are making arrangements to market the cotton in Poland as produced in increasing quantities.

553. RUSSIA: COTTON CULTIVATION IN RUSSIAN CENTRAL ASIA. By G. Fürbringer. (*Wirtschaftsdienst*, **20**, 1935, p. 676. From *Summ. of Curr. Lit.*, xv., **12**, 1935, p. 300.) The Russian plan for extended cotton cultivation in Central Asia, recent progress and factors retarding development are discussed. Projected irrigation systems and synthetic fertilizer plants are briefly described.

SOILS AND MANURES.

554. PROCEEDINGS OF THE SECOND CONFERENCE OF EAST AFRICAN AGRICULTURAL AND SOIL CHEMISTS. (Govt. Printer, Nairobi, 1935.) The second Conference was held at the Agricultural Research Station, Amani, Tanganyika Territory, in August, 1934. Among the subjects discussed were the following: The East African Soil Map; Registration of soil series names, and locality-names of larger soil units; Biological methods of assay for available nutrients in soils or for detection of soil deficiencies; Green Manuring *v.* Compost Making; Texture-assessment in soils; Soil and climatic factors necessary for the best growth of particular crops, *e.g.* tobacco, citrus, coffee; The collection of experience of various methods of minimizing soil erosion; Pastoral problems, *e.g.* manurial deficiencies.

555. EGYPTIAN SOIL: DETERIORATION. By D. S. Gracie *et al.* (*Min. Agr. Egypt. Tech. Sci. Serv. Bull. No.* 148, 1934. From *J. of Text. Inst.*, xxvi., **5**, 1935, A230.) A preliminary account is given of the causes and nature of the deterioration of fertile Egyptian soils. It is based on evidence obtained in cases where the owner or occupier had reason to complain about the unsatisfactory condition of his land. The changes in soil conditions in Egypt originate in the almost universal replacement of the basin system of irrigation by, very largely, free flow perennial irrigation. In land perennially irrigated natural drainage may or may not be good, and artificial drainage, apart in some cases from main drains, which scarcely anyone uses, does not exist. Deterioration of land under perennial irrigation can always be associated with the existence of a high-water table which has persisted over a variable period of time. The changes in the nature of the soil produced by a persistently high-water table are described, and the effects of soil deterioration on yields of cotton and maize are studied. The necessity for drainage and the prospects of amelioration of deteriorated land are discussed. Analytical figures are given for seven representative soil profiles.

556. ORGANIC BASE-EXCHANGE COMPOUNDS IN SOILS. By W. T. McGeorge. (*J. of Amer. Soc. Agron.*, 26, **7**, 1934, p. 575. From *Exp. Sta. Rec.*, 72, **3**, 1935, p. 299.) Green manures and crop residues, including plant roots, showed themselves capable of increasing materially the base-exchange capacity of such soils as were examined by the author of this contribution from the Arizona Experiment Station, who further considers that an inorganic fraction of plant material also possesses the property of base exchange. "Whether of the nature of isoelectric precipitates or synthetic zeolites, the bases absorbed by the inorganic fraction of this exchange complex, as well as those absorbed by the organic

fraction, should be in an easily available form because of their non-crystalline structure."

557. A COMPARISON BETWEEN THE PIPETTE METHOD AND THE HYDROMETER METHOD FOR MAKING MECHANICAL ANALYSES OF SOIL. By G. J. Bouyoucos. (*Soil Sci.*, 38, 5, 1934, p. 335. From *Exp. Sta. Rec.*, 72, 4, 1935, p. 449.) With the co-operation of the U.S.D.A. Bureau of Chemistry and Soils, the author of this contribution from the Michigan Experiment Station compared his hydrometer method for the mechanical analysis of soils with the standard pipette method, finding that what the pipette method determines as coarse clay (0·005 mm.) the hydrometer method would determine at the end of one hour, and what the pipette method determines as fine clay (0·002 mm.) the hydrometer method would determine at the end of two hours. "The results obtained show that the two methods agree exceptionally well on the determination of the coarser clay (0·005 mm.). On the determination of the fine clay (0·002 mm.) they do not agree very closely on some soils, but on the majority of soils they agree satisfactorily. The disagreement between the two methods in some soils seems to be due to differences in dispersion. A new stirrer is now employed in place of the original one. In this new stirrer the paddle is made of hard steel, and when it becomes worn it can be unscrewed from the stirring rod and replaced with a new one. On account of its great simplicity and rapidity, and its reasonable accuracy, it seems that the hydrometer method has many distinct advantages over all other methods."

558. RELATIONSHIPS OF ROOTS, SOIL PROFILE, AND IRRIGATION IN THE SUDAN. By F. E. Kenchington. (*The Journal*, S.E. Agr. Coll., Wye, No. 36, July, 1935, p. 135.) I. *Descriptive.* The Shambat research farm near Khartoum occupies a shallow basin of "*Karu*" soil which resembles the neighbouring Gezira "*Babob.*" Both soils are products of arid or semi-arid weathering; both are heavy clays, brown or grey in colour, salty, alkaline and feebly permeable to water. Other features common to *Karu* and *Babob* are the presence of calcareous nodules, a low content of humus, extreme stickiness when wet, and the formation of cracks on drying. *Karu*, *Babob* and the dark clay of Upper Nile Province (a more humid region) are regarded as a natural soil type for which the name *Teen Suda* is proposed. This covers a triangular area extending from the Nile basin to Lake Chad; the *Regur* soils of India apparently conform to the same type. In the Southern Hemisphere *Teen Suda* is to be expected in Brazil (no data), and in South Africa (the *Vlei* soils); it undoubtedly includes the black inland soils of North Australia. As the author's personal observations are limited to a part of the Sudan, this broad survey necessarily awaits confirmation.

II. *Experimental.* (*a*) At Shambat, roots of Sakel cotton are largely confined to the top foot or so of soil. Below this there is a kind of pan (Horizon II.), tough, salty, and scarcely affected by rain or irrigation. Abortion of the root tip is common, but when a tap root or a substitute succeeds in finding a path through this layer it strikes a more favourable medium (Horizon III.). Long shallow laterals are typical; fine rootlets, limited in quantity, are of two kinds: white, aerobic, and yellow, anaerobic. Under anaerobic conditions plant growth continues after decay of the white rootlets. Irrigation presents difficulties owing to the severe climate on the one hand and the danger of waterlogging on the other.

(*b*) Large samples of a typical *Karu* profile were taken in 10 cm. steps, and used in culture experiments. Samples representing Horizon I. permitted normal growth of cotton; notably poor growth was obtained from samples of Horizon II., while growth from soil of Horizon III. was intermediate. The interesting observation was made that these differences in growth practically disappeared a year later when a second crop of plants was raised from the same soil. As

indicated by rate of water movement, the physical state of the soil, and particularly that of Horizon II., had improved during one year's use as culture media in boxes.

The author expresses misgivings as to the future of irrigation enterprises on *Teen Suda* soils.

559. SOIL AND FERTILIZER STUDIES OF THE BUREAU OF CHEMISTRY AND SOILS. (*U.S. Dpt. Agr. Bur. Chem. and Soils Rpt.*, 1934. From *Exp. Sta. Rec.*, 72, **4**, 1935, p. 448.) The work reported on includes soil erosion investigations, fertility investigations with cotton and other crops, fertilizer studies, concentrated fertilizers, green manure, mechanical placement of fertilizers, soil-type response to magnesium compounds, preparation of phosphate fertilizers, and mixed fertilizers.

560. FLORIDA: COTTON NUTRITION STUDIES. By R. M. Crown. (*Flor. Agr. Exp. Sta. Ann. Rpt.*, 1934, p. 118.) The different fertilizer formulas used in triplicate plots at the rate of 500 lb. per acre were: 0-8-7, 2-8-7, 4-8-7, 6-8-7, 8-8-7, 4-0-7, 4-4-7, 4-6-7, 4-10-7, 4-8-0, 4-8-4, 4-8-12. Significant increases in yield over the 4-8-7 formula were obtained from the plots where the 6-8-7, 4-0-7, and the 4-8-0 formulas were applied. In 1932, more cotton generally was produced on plots following peanuts than on those which followed corn. 500 and 750 lb. of a 4-8-7 fertilizer yielded 13 and 40 per cent. greater yields than only 250 lb. of the same mixture, and those plots where no fertilizer was applied yielded 62 per cent. less than those where 500 lb. of this fertilizer were applied. All these increases, according to statistical analysis, were significant.

561. EXPERIMENTS WITH NITROGEN FERTILIZERS ON COTTON SOILS. By J. J. Skinner *et al.* (*U.S. Dpt. Agr., Tech. Bull.* 452, 1934. From *Exp. Sta. Rec.*, 72, **4**, 1935, p. 455.) Results of experiments are reported showing the relative effects of various sources of inorganic, synthetic, and organic nitrogen in fertilizers for cotton on the principal soils of the south-eastern Cotton Belt, especially in North Carolina.

On many soils there was not a wide variation in yield of cotton from fertilizers containing phosphoric acid and potash with different sources of nitrogen, such as sodium nitrate, ammonium sulphate, ammonium nitrate, urea, Leunasalpeter, and ammonium phosphate. In some of the experiments ammonium chloride gave slightly lower yields. Fertilizers containing nitrogen derived partly from quickly available inorganic or synthetic nitrogen, and partly from slowly available organic nitrogen of vegetable or animal-waste origin, gave larger returns on some soils than fertilizers containing only quickly available inorganic or synthetic nitrogen, while on other soils quickly available nitrogen gave as good results as a mixture of the two types of nitrogen carriers.

562. BASIC SLAGS AND MINERAL PHOSPHATES. By E. M. Crowther. (Reprinted from *J. of Roy. Agr. Soc. of Eng.*, vol. 95, 1934.) A review of recent work in this country and abroad.

563. STUDIES ON CALCIUM CYANAMIDE. V.: THE UTILIZATION OF CALCIUM CYANAMIDE IN POT CULTURE EXPERIMENTS. By H. L. Richardson and E. M. Crowther. (*J. of Agr. Sci.*, xxv., **1**, 1935.)

564. THE RELATIONSHIP BETWEEN SOIL AND RAIN, WITH REFERENCE TO SOIL EROSION. By H. H. Cornell. (*Farming in S. Afr.*, May, 1935, p. 210.) Two conditions are necessary before soil erosion can commence. First, there must be unabsorbed water, *i.e.*, run-off water; and secondly, the run-off water must move at a certain speed. These conditions are controlled by the following factors, which are discussed separately: (1) the texture and structure of the soil; (2) physical condition of the soil surface; (3) total amount of rain; (4) nature

(distribution) of the rain; (5) vegetal cover on the soil; and (6) slope or gradient of the surface.

565. MEASURES AGAINST SOIL EROSION IN TANGANYIKA TERRITORY. By E. Harrison. (*East Afr. Agr. Jour.*, vol. i., No. 1, July, 1935, p. 14.) A brief note, illustrated by photographs, showing the value of contour ridges for combating soil erosion at the Lubaga Experiment Station, Shinyanga, Tanganyika Territory.

566. EROSION CONTROL STRUCTURES: DROP INLETS AND SPILLWAYS. By L. H. Kessler. (*Wisconsin Sta. Res. Bull.* 122, 1934. From *Exp. Sta. Rec.*, 72, **5**, 1935, p. 700.) Presents the results of an analysis of the hydraulic characteristics of certain types of concrete conduits, flumes, and spillways used with earth-filled, soil-saving dams for erosion control.

567. LATEST RESULTS OF ENGINEERING EXPERIMENTS AT THE SOIL EROSION EXPERIMENT STATIONS. By C. E. Rameer. (*U.S.D.A. Bur. Agr. Eng.*, 1934. From *Exp. Sta. Rec.*, 72, **5**, 1935, p. 700.) Data indicate that the control of erosion in the terrace channel can be accomplished to a limited extent by the shape of the channel. The height of the terrace also largely determines the cross-sectional area of the waterway for any particular slope.

568. THE RELATION OF GRASS COVER TO EROSION CONTROL. By H. H. Bennett. (*Rhod. Agr. Jour.*, xxxii., **6**, 1935, p. 385.) The author of this paper is director of the U.S.A. Soil Erosion Service. The importance is stressed of grass as a means of controlling erosion, since where there is a good cover of grass there is no serious problem of erosion. It is unfortunate that terracing should be so generally considered as the only method of control. "The method of attack employed by the Soil Erosion Service is essentially a co-ordinated plan of correct land use. This plan involves not only the use of direct methods of retarding erosion (which necessarily calls for retardation of run-off by increasing absorption of the rainfall), but the use of indirect methods, such as the retirement from cultivation of steep, highly erosive areas from which accelerated run-off (resulting from incorrect land usage) descends with destructive effect upon lower-lying cultivated areas. Such retired critically vulnerable lands are being planted with thick soil-holding crops, such as trees, grass, alfalfa, lespedeza, sorghum, and clover. Part of the cultivated land is being protected with the new system of strip cropping, under which clean-tilled crops, such as cotton, corn, and tobacco (the real producers of erosion), are being grown between parallel bands of grass, lespedeza, sorghum, and other dense crops planted across the slopes, on the level, *i.e.*, along the contours. These later crops catch rain-water flowing down the slopes, spread it out, and cause the suspended soil to be deposited and most of the water to be absorbed by the ground, thus protecting the crops growing on the ploughed strips below. On certain slopes strips of permanent protective cover will be planted according to the French system, using trees, shrubs, and vines. Here is an opportunity to make advantageous use of nut trees, persimmon, honey locust (producing feed for livestock), briar crops, and other plants of economic value. It is hoped that it may be possible on some of the project areas to employ the Ecuadorian system of protecting steep slopes by bordering the downhill sides of rectangular fields with soil-holding hedges. Field terraces (embankments adjusted to the contours) are being employed where applicable, and in some localities it is planned to scarify certain types of land, especially summer-fallowed ground, with a machine which scoops out 10,000 basin-like holes to the acre, each of which retains about 5 gallons of rain, causing it to sink into the ground where it falls. Machines for this purpose are now being manufactured. Soil-conserving crop rotations are being practised, and cover crops

and other control measures are being employed. Every farm is surveyed in advance of actual work by specialists of the local erosion staff. Soils, slopes, and extent of erosion are plotted on accurate maps."

569. TERRACING IN ALABAMA. By A. Carnes and J. B. Wilson. (*Ala. Poly. Inst. Ext. Circ.* 148, 1934. From *Exp. Sta. Rec.*, 72, **5**, 1935, p. 701.) It has been found that the so-called Nichols terrace is the most satisfactory for Alabama conditions. It consists essentially of a broad shallow ditch, with a moderate-sized mound on the lower side. Since this terrace carries most of the water below the surface of the ground, complete failures rarely occur.

CULTIVATION, IRRIGATION, GINNING, ETC.

570. LARGE-SCALE RESEARCH IN CROP PRODUCTION—COTTON. (*Nature*, May 18, 1935, p. 805.) A very favourable review of the work of the Experiment Stations of the Empire Cotton Growing Corporation, season 1933-34. Attention is directed to the bold development of which the Corporation's work is a good example; and the complex character of the research for which the Experiment Stations exist is described in brief.

571. COTTON PRODUCTION. (*Textielind*, xvi., 1935, pp. 1 and 45. From *Summ. of Curr. Lit.*, xv., **10**, 1935, p. 241.) A general account of cotton-growing and ginning. The article is noteworthy for the excellent illustrations.

572. IAROVIZATION OF COTTON. (Trans. title.) By N. P. Zinichenko. (*Bor'ba Khlopok*, Nos. 2-3, 1933. From *Exp. Sta. Rec.*, 72, **3**, 1935, p. 321.) Vernalized seed of American cotton varieties hand-sown just after treatment emerged earlier, growth, square formation, blooming and ripening were accelerated, bolls were larger, and substantial yield increases over controls usually were obtained. Even seed dried to normal moisture content and planted about fifteen days after treatment gave good yield increases.

573. IAROVIZATION OF COTTON. (Trans. title.) By A. N. Tashlanov and Z. M. Pulovkina. (*Bor'ba Khlopok*, Nos. 1-2, 1934. From *Exp. Sta. Rec.*, 72, **3**, 1935, p. 321.) Seedlings from vernalized cotton seed emerged several days before controls, and certain Egyptian and American varieties respectively bloomed from 3 to 6 and from 1 to 3 days earlier, and ripened from 5 to 11 and from 2 to 4 days earlier than controls. Substantial yield increases were noted in the first pickings, depending on variety. Usually no differences were noted in boll size and fibre length and percentage. Varietal differences were evident.

574. VERNALIZATION AS A METHOD OF IMPROVING THE QUALITY AND INCREASING THE YIELD OF COTTON. By A. V. Novikov. (*Sredaz NIHI*, Moscow and Tashkent, 1934.) Yield increases have been obtained on all the vernalized cotton plots, some of which were of an area of six hectares and over. These yield increases were obtained even from cotton grown under the most favourable cultural conditions, and are almost entirely to be observed in the first picking—*i.e.*, before the beginning of the early frosts, and in many cases the length of the lint was also increased.

Some varieties, after vernalization, displayed a certain acceleration in the time at which the various developmental stages set in. Other varieties did not react at all, whilst still others reacted negatively to a twenty-day treatment and positively to a fifteen-day treatment. Some varieties have even given varying effects in different experiments, showing that the method requires further elaboration.

The technique of vernalization for cotton is described. Each variety must be treated with the right conditions of temperature and moisture for the requisite

length of time, and the determination of this time, which may vary for each variety, has been one of the main difficulties. Richter has found that vernalized embryos are coloured blue by methylene blue in buffer solutions of suitable pH, whilst unvernalized embryos go pink. The isoelectric point is thus changed by vernalization, and it is now possible to determine accurately when a seed has been correctly vernalized.

Acala 8517 gave the greatest response, with an increase of 13 per cent. in total yield, and 27·2 to 36·0 in first picking. The varieties that reacted most with regard to early flowering and maturity also gave the greatest increase in yield from first picking. This was most marked in the Egyptian varieties. The lint length and ginning percentage both tended to be higher in the vernalized plants in the American cottons, whilst in the Egyptians the lint length was slightly reduced though the ginning percentage increased. Flowering showed an acceleration usually of three to four days, but amounted to thirteen days for Navrotskii and nine days for Ashmouni.

Great results have not yet been achieved, but vernalization will doubtless be worth while, and the question deserves very careful study.

575. COTTON PLANT: INTERVARIETAL COMPETITION IN YIELD TRIALS. By B. G. Christidis. (*J. Agr. Sci.*, 25, 1935, p. 231. From *Summ. of Curr. Lit.*, xv., **12**, 1935, p. 301.) Nine varieties of cotton were used in a variety test planned according to the randomized block system. At harvest every row was picked and weighed separately, and after the leaves of the plants had dried up and fallen the height of the main stem of every plant was measured. The results are tabulated. The yield data show a variation ascribed to competition, which varies from zero to ± 6 per cent. Two groups can definitely be distinguished as including the best and the worst competitors. However, the best yielder is not always the best competitor, or *vice versa*. The height-of-plants data do not show any indication of competition, presumably owing to an opposite effect of shading. The competitive value of a variety depends on that of the other varieties with which it is grown in competition. These results suggest that competition may cause a definite bias in estimating the comparative yielding value of cotton varieties. Field trials should therefore be arranged so that competition effects between different varieties will be eliminated.

576. APPLICATION OF MODERN STATISTICAL METHODS TO YIELD TRIALS. By D. S. Rajabhooshanam. (*Agr. and Livestock in Ind.*, v., **2**, 1935, p. 145.) Discusses the subject under the following heads: The Problem; Some Relevant Statistical Concepts; Randomized Blocks; The Latin Square; Seasonal Factor in Yield Trials, etc.

577. THE 6×6 LATIN SQUARES. By R. A. Fisher and F. Yates. (*Proc. Camb. Phil. Soc.*, 30, 1934, p. 492. From *Pl. Bre. Absts.*, v., **4**, 1935, p. 277.) Since the correct application of the Latin Square design in field experimentation depends on the ability to select a square at random from all possible squares of a given size, the mathematical problem of their enumeration is of importance. This problem has only hitherto been solved completely for squares up to size 5×5. In this paper the enumeration is carried out for 6×6 squares by means of an intramutation process, and gives 9408 as the number of "reduced" squares, thus correcting an earlier estimate of 8192. It is shown how the aggregate of 6×6 squares may be derived from only seventeen examples, which are given in the paper.

578. THE USE OF "DIFFERENTIAL REGRESSION" IN ANALYSIS OF VARIANCE. By W. A. Hendricks. (*J. Agr. Sci.*, 25, 1935, p. 258. From *Pl. Bre. Absts.*, v., **4**, 1935, p. 277.) A further elaboration of the method of analysis of

co-variance in dealing with experimental data is proposed, and illustrated in two cases. Briefly, the method involves the separate calculation of regression coefficients for lots of data subject to different treatments, and it is claimed that the results of statistical analysis may be misleading when this is not done, owing to the occurrence of "differential regression." The test for the significance of differences among the various regressions is not, however, given, although it has been published.

579. Effect of Storage Prior to Ginning on the Spinning Quality of Cotton. By N. Ahmad. (*Tech. Bull. Ser. B.* No. 19, Ind. Cent. Cott. Comm., 1935.) Storage of cotton in seed for four weeks before ginning had no effect whatever either upon its mean fibre-length or fibre-weight per inch. The results of the tests do not support the view that the development of the cotton fibre continues after picking during the period of storage of seed-cotton. Similarly, the other view that during storage oil diffuses from the seed into the fibre is not confirmed by the results of wax determination. Only in the case of one cotton, P.A. 289F., the wax content of the stored sample was found to be significantly higher than that of the early-ginned sample. As against this, P.A. 4F. gave just the opposite result, the wax percentage of the stored sample being actually *less* than that of the sample ginned immediately after picking, while the difference between the values of wax content for the two types of samples of the third cotton, Mollisoni, was negligible.

The results of the spinning test show that the yarns spun from the sample of P.A. 289F., which was stored before ginning for four weeks, were stronger and more even than those given by the early ginned sample of the same cotton.

COTTON SEED AND OIL.

580. Development of Standards for Grades of Cotton Seed. By G. S. Meloy. (*U.S. Dpt. of Agr. Div. of Cott. Marktg.*, Washington, D.C., June, 1935.) Standard grades and standard methods of sampling, analyzing, and grading cotton seed have been established for use in the purchase and sale of cotton seed intended for crushing. In practice, the quantity index is considered as a whole number and the grade as that percentage of the quantity index indicated by the quality index. For example, if the quantity index is 110 and the quality index is 90, then the grade is 90 per cent. of 110 or 99.

These standards are permissive in that it is left to the option of the parties whether to use the standards or not. Although it is unquestionably the right of either the seller or the purchaser to exercise his option, until the sellers of cotton seed better appreciate the value of selling on grade, it may happen that the option of using the standards will be left primarily to the cottonseed-oil mills, which are the ultimate purchasers of cotton seed. Manifestly, in a given district all transactions must be based either on the standards or off the standards, or the option might be exercised as a means of unfair competition. Therefore, until the use of the standards is made mandatory, the use or non-use of the standards by the crushing mills must be the result of unity of action or agreement among the mills.

Two factors apparently influence such unity of action: (1) the probability of a variable development in the seed produced in a district and the frequency of deterioration; and (2) the admission on the part of the majority of the industry in any given section that superiority in cotton seed should be recognized and rewarded by premiums.

581. Dormancy and Maturity of Cotton Seed. By D. M. Simpson. (*J. Agr. Res.*, **50**, 5, 1935, p. 429.) Experiments conducted at James Island, near

Charleston, South Carolina, indicate that freshly opened cotton bolls contain a considerable percentage of dormant seed. This dormancy may be eliminated by drying and storing the seed for a short period. There was no appreciable difference in dormancy of fresh seed among several Upland varieties; the Sea Island strain tested showed practically no dormancy. Studies of seed maturity indicated that cotton seed reaches maturity shortly before the bolls begin to open; at James Island, South Carolina, this period is from forty to fifty days after flowering.

582. VIABILITY OF COTTON SEED AS AFFECTED BY FIELD CONDITIONS. By D. M. Simpson and B. M. Stone. (*J. Agr. Res.*, **50**, 5, 1935, p. 435.) Seasonal fluctuations in the germination of cotton seed have been attributed to climatic conditions during the harvesting season, but the definite relationship of rainfall, humidity, and temperature to the viability of the seeds has received little attention. Experiments conducted at James Island, South Carolina, in 1931-32-33, under conditions of frequent rainfall and high humidity, provide information on these conditions.

Cotton harvested at James Island normally contains excessive moisture. Determinations of the moisture content of seed during the period of boll opening showed that seed from bolls just cracking open contained approximately 50 per cent. moisture, and that seed from partially opened bolls, which are ordinarily harvested by the pickers, may contain more than 28 per cent. moisture. Dry weather caused rapid reduction in the moisture content of the seed and seed cotton, but rainy, humid, or cool weather prevented drying and delayed boll opening.

The low viability of seed harvested in unfavourable weather indicates that seed deterioration occurs in the field before harvesting. Seed from bolls just opening, when dried and stored for a short time, gave higher germination percentages than seed which had been exposed for a longer period in the field.

Data on the viability of seed taken from bolls exposed for varying lengths of time in the field showed that deterioration of the seed was correlated with rains or humid conditions which prevented the prompt drying of the seed cotton after the bolls began to open. Seed from bolls opening and harvested during periods of dry weather gave higher germination percentages than did seed from bolls opening and harvested during rainy weather. Differences in resistance to field deterioration were apparent among the varieties tested, and the possibility of improvement in the germinating qualities of cotton seed by selective breeding is suggested.

583. RELATION OF MOISTURE CONTENT AND METHOD OF STORAGE TO DETERIORATION OF STORED COTTON SEED. By D. M. Simpson. (*J. Agr. Res.*, 50, **5**, 1935, p. 449.) Storage experiments with Sea Island and Upland cotton seed under the humid conditions prevailing at James Island, South Carolina, showed that in ordinary storage cotton seed deteriorates rapidly after two years. A definite relation is indicated between the moisture content of the seed during storage and the rapidity of deterioration. Sea Island seeds, with a moisture content reduced below 8 per cent., when stored in tin containers to prevent the rapid reabsorption of moisture, retained their germination percentage with only slight impairment for four and a half years. Upland cotton seed stored under various conditions and containing from 8·75 to 13·89 per cent. moisture deteriorated rapidly when the moisture in the stored seed remained above 10 per cent. Dried seed stored to prevent reabsorption of moisture showed only slight deterioration after two and a half years. Seed containing 13·78 per cent. moisture and stored to prevent drying were all dead nine months after the beginning of storage.

584. Action of an Electric Current on Cotton Seed. (Trans. title.) By I. I. Iakobson. (*Bor'ba Khlopok*, Nos. 1-2, 1934. From *Exp. Sta. Rec.*, 72, **3**, 1935, p. 321.) Passage of a 0·05-ampere current through cotton seed soaked in a sodium chloride solution is said to have accelerated germination two to three days, and in experimental plants increases of from 10 to 20 per cent. in bolls per plant and from 9 to 20 per cent. in seed cotton per boll over controls were reported. Limitations of the method are indicated.

585. Cotton Seed By-Products: Value. (*Cotton Oil Press*, xviii., **12**, 1935, p. 33. From *Summ. of Curr. Lit.*, xv., **12**, 1935, p. 301.) An example is given of literature that is being distributed by the Georgia Cotton Seed Crushers' Association to stimulate cotton production. The food value of the by-products such as cottonseed oil and meal is particularly stressed, the data being expressed in equivalents of corn, oats, and so forth.

PESTS, DISEASES, AND INJURIES, AND THEIR CONTROL.

586. Report of the Chief of the Bureau of Entomology, 1934. By L. A. Strong. (*U.S. Dpt. Agr. Bur. Ent. Rpt.*, 1934. From *Exp. Sta. Rec.*, 72, **5**, 1935, 652.) Work on insects attacking cotton plants included control of the boll weevil by arsenicals and parasites (*Microbracon mellitor*, *Eurytoma tylodermatis*, and *Catolaccus hunteri*), control of the pink bollworm by cultural methods and parasites (*M. brevicornis* and *Exeristes roborator*), and control of the cotton flea hopper, bollworm, and Thurberia weevil.

587. Cotton Pests in Antigua. (*Trop. Agriculture*, xii., **7**, 1935, p. 197.) A serious outbreak of cotton pests was experienced in February. At Morris Bay the cotton was covered with a thick incrustation of the black scale (*Saissetia nigra* Nietn.) and the foliage was heavily infested with cotton aphis; both pests, however, were heavily attacked by local natural enemies.

Cotton stainers were present in numbers, and in some cases the damaged bolls amounted to 100 per cent. A count was made to determine the infestation by pink bollworm, which was found to be 66 per cent. In December the infestation fell to 16 per cent. These facts are interesting in that they demonstrate the increase of the pest at a time of the year which has been assumed to coincide with the resting stage.

588. A Synopsis of Cotton Insects in China. By F. Li and T. Ma. (*Yearb. Bur. Ent. Hangchow.*, 3, 1933, p. 185. From *Rev. App. Ent.*, xxiii., Ser. A, 6, 1935, p. 306.) A preliminary list is given of 116 pests of cotton in China, including data (most of which is recorded for the first time), on their distribution and alternative food-plants, the stage of each species that is injurious, and the part of the cotton plant it attacks. The most important include *Oxycetonia jucunda*, Fald., and *Popillia mutans*, Newm., which only feed on cotton in the adult stage, *Platyedra gossypiella*, Saund., *Agrotis c-nigrum*, L., *A. ypsilon*, Hfn., *Earias cupreoviridis*, Wlk., *Heliothis obsoleta*, F., *Sylepta derogata*, F., *Aphis gossypii*, Glov., *A. maidi-radicis*, Forbes, *Atractomorpha ambigua*, Boliv., *Gryllus mitratus*, Hagenbeek, *Gryllotalpa africana*, P. de B., *Thrips tabaci*, Lind., and *Tetranychus telarius*, L.

589. Note on a New Light Trap. By J. J. de Gryse. (*Rpt. Ent. Soc. Ont.* 1933, **64**, p. 55, Toronto, 1934. From *Rev. App. Ent.*, xxiii., **5**, 1935, p. 235.) A diagram and description of a new light trap for Lepidoptera are given. A large galvanized iron funnel fits into a neck in the lid of a bucket-shaped, copper receptacle. The height of the funnel is 24 inches, and its diameter 24 inches at the mouth and 4½ at the neck. The receptacle is 14 inches high and measures 10 inches across at the top and 7 to 8 at the bottom. Two vertical glass plates are fitted on opposite

sides of the mouth of the funnel to catch insects circling round the light. An ordinary electric bulb, a daylight bulb or a good lantern is suspended between the glass plates nearly on a level with the funnel's rim. A set of four movable trays, fitting closely one into the other and pierced with circular openings of a gradually decreasing diameter ($\frac{5}{8}$ to $\frac{1}{8}$ inch), are mounted inside the receptacle. The lowest tray is made of a fine copper screen. These trays separate the insects according to size and prevent crowding and mutilation. A layer of cotton-wool saturated in carbon tetrachloride is placed underneath the lowest tray. A small tin filled with cotton-wool soaked in carbon tetrachloride and covered with a perforated lid is placed on each tray. The carbon tetrachloride should be renewed every night, and $\frac{3}{4}$ gallon should suffice for one season. The insects are stupefied almost at once and need to be relaxed before they can be pinned.

590. History and Control of the Boll Weevil in Oklahoma. By C. E. Sanborn *et al.* (*Bull. No.* 222, Agr. Exp. Sta., Oklahoma, 1934.)

591. Bollworm Active in Egypt. (*Text. Wkly.*, 15, **382**, 1935, p. 698.) The Minister of Agriculture has issued an urgent appeal to all farmers to co-operate with the Government in a campaign against the bollworm, which threatens to do greater damage to the cotton crop than ever before. The exceptional heat at the end of April and the beginning of May caused the eggs of the cotton moth to hatch out earlier than usual, and in consequence the bollworm has spread far and wide. Upper Egypt is exempt owing to its drier and hotter climate, but the Delta, where the damp and relatively cool air favours insect life, is seriously affected. The Minister urges landowners to spare no expense in engaging extra hands to clear the bollworm from their cotton plants.

592. Pink Bollworm of Cotton (*Platyedra gossypiella*) in Montserrat. (*Trop. Agriculture*, xii., **7**, 1935, p. 196.) Hosts of the pink bollworm during the close season for cotton were (1) the Seaside Mahoe or John Bull tree (*Thespesia populnea*) and (2) wild cotton (*Gossypium*). The local Government has arranged for the destruction of *Thespesia* wherever it occurs in Montserrat, and also for the destruction of wild cotton plants and a thorough clean-up of the localities where they have been found. Other cotton pests in the island included cotton stainers (*Dysdercus andreæ* L.), which were literally swarming on *Thespesia* at Little Bay in March. Mole crickets (species undetermined) are stated to injure germinating seedlings.

593. An Entomological Investigation in St. Vincent. By J. G. Myers. (*Trop. Agriculture*, xii., **6**, 1935, p. 139). *Cotton Insects.*—The major pests of St. Vincent are cotton stainers, pink bollworm, and cotton aphis. They are being combated with considerable success by three main methods—viz., rigid close season, destruction of alternate host-plants, and breeding of resistant varieties of cotton. In the opinion of the author, however, the only economic means of avoiding the constant menace, and saving the appreciable loss inflicted by pests on the cotton industry, is biological control.

594. Preliminary Notes on the Cotton Bollworm *Chloridea obsoleta* Fab. By K. Lui. (In Chinese.) (*Ent. and Phytopath.*, ii., **27**, p. 528. Hangchow, 1934. From *Rev. App. Ent.* xxiii., Ser. A, **4**, 1935, p. 205.) In China larvæ of *Heliothis* (*Chloridea*) *obsoleta* F. appear on cotton early in July, when it is a little over 3 feet high. An account is given of the life history of the pest and the control measures recommended.

595. Preliminary Notes on the Life History of the Cotton Cutworms, *Agrotis* Spp. By F. Li. (In Chinese.) (*Ent. and Phytopath.*, ii., **31**, p. 608. Hangchow, 1934. From *Rev. App. Ent.*, xxiii., Ser. A, **4**, 1935, p. 205.) An

unidentified species of *Agrotis*, which has one generation a year in China, and hibernates in the larval stage, causes serious damage to young cotton plants from the beginning of May to mid-June. The prepupal stage lasts from towards the end of June to mid-September. The adults emerge in early October and oviposit over a period of ten days. One female lays an average of 435 eggs. The eggs hatch at the end of October. *A. ypsilon* Hfn., which has three generations a year, also causes severe injury to young cotton plants in May. One female lays about 800 eggs.

596. Locust Problem in Africa. By B. P. Uvarov. (*Rep. Afr. Affairs*, v., 1933, London, 1934. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **2**, 1935, p. 68.) Suggests the establishment of a permanent international organization for the control of outbreak centres.

597. Comision Nacional de Defensa contra la Langosta. Lucha Nacional contra la Langosta. Contribucion Cientifica de la Sociedad Entomologica Argentina. (Buenos Aires, Minist. Agric. Argent., 1934. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **2**, 1935, p. 74.) Contains the papers presented at the meetings of the Argentine Entomological Society to discuss the locust problem.

598. Comision Central de Investigaciones Sobre la Langosta. Informe de las Comisiones Exploradoras, Mayo a Agosto de 1933. (Buenos Aires, Minist. Agric. Argent., 1934. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **2**, 1935, p. 73.) Reports of the exploring commissions sent out by the Central Commission of Locust Investigations in Argentina in the winter of 1933, to investigate the supposed winter "refuges" of *Schistocerca paranensis* Burm., in that country.

599. A General Investigation of the Locust (*Locusta migratoria* L.) Outbreaks in China during the Year 1933. By F. C. Woo and T. S. Cheng. (In Chinese, with a summary in English.) (*Spec. Publ. Nat. Agr. Res. Bur. No.* 5, Nanking, 1934. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **1**, 1935, p. 46.) The locusts of the first generation were present from mid-April to the end of August, and those of the second from mid-June to mid-October. Particulars are given of the sites on which eggs were laid by the second generation, and of the area infested, as well as of the general distribution of the locusts throughout the country, and maps illustrate the direction of migrations. The crops attacked were cereals, reeds, bamboo, cotton, sugar-cane and soy beans, and the loss sustained was estimated at nearly 15 million Mexican dollars.

600. Invasão da Colonia por Gafanhotos. By P. A. Fragosa Viana. (*Bol. Agric. pecuario*, 1933, Nos. 1-4, Lorenzo Marques, 1934. Abstr. from *Rev. App.* Ent., xxiii., Ser. A, **2**, 1935, p. 99.) Deals with the locust situation in Mozambique.

601. Schistocerca paranensis Burm. Bemerkungen über den Heuschreckeneinfall am Alto Parana im September 1933. By H. Jacob. (*Ent. Jahrb.*, 44, Leipzig, 1935. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **2**, 1935, p. 92.) In Paraguay many locusts were killed by feeding on bundles of favourite food-plants, particularly a stinging nettle, *Urcra caracasana*, to which a liquid bait of sugar, syrup or honey, and arsenic had been applied.

602. Los Cebos Toxicos para Combatir la Langosta. By A. Weiss. (*Publ. Dir. Agron. Minist. Industr. Uruguay*, vii., **3**, 1934. Abstr. from *Rev. App. Ent.*, xxiii., Ser. A, **2**, 1935, p. 61.) Two formulæ for poison baits tested against *Schistocerca paranensis*, Burm., in Uruguay, consisted respectively of 100 lb. coarse bran, 0·2 gal. 65 per cent. solution sodium arsenite, 0·8 gal. molasses, and 6·5 gals. water, and of 70 lb. coarse bran mixed with 35 lb. fine bran, 0·2 gal. Cooper's locusticide and 10 gals. water. Both proved very effective, and cost only about a third as much as control by means of barriers. The second formula

was slightly cheaper, but the first acted more rapidly, the locusts beginning to die within twenty-four hours of its application. Detailed tables of the results are given as well as instructions for the preparation and application of bait.

603. Ensayos a Campo del "Hongo Verde" ("Sporotrichum paranense" March) de la Langosta Voladora. By J. B. Marchionatto and J. Vallega. (*Bol. Mens. Min. Agr. Nac.*, xxxv., 1-3, Buenos Aires, 1933, Abstr. from *Rev. App. Mycol.*, xiii., **12**, 1934, p. 766.) Particulars are given of field experiments in Santo Tome and Parana, Argentina, with the so-called "green fungus" (*Sporotrichum paranense*) of the winged locust (*Schistocerca paranensis*), from which it appears that even under conditions relatively unfavourable to the fungal parasite a mortality up to 65 per cent. of the insects may be attained by spraying the latter with spore suspensions. The effects of the fungus do not begin to be felt by the locusts for at least five days after inoculation, so that speedy destruction cannot be accomplished by this method. However, in view of its facility of cultivation and application, the "green fungus" should be further tested in districts where the locusts spend a considerable part of the winter.

604. The Locust Fungus: Its Artificial Cultivation. By A. McMartin. (*S. Afr. Sugar Jour.*, xviii., **9**, 1934, p. 521. Abstr. from *Rev. App. Mycol.*, xiv., **2**, 1935, p. 98.) After repeated attempts to cultivate the locust (*Nomadacris septemfasciata*) fungus (*Empusa grylli*) from newly dead insects, cultures were eventually obtained on a liquid medium consisting of maltose, glycerine, and peptone. A genetic connection was traced between the yeast-like bodies representing the early stages of infection in the locusts and the conidial stage. As the fungus is not an obligate parasite there is a possibility that it may persist on dead organic material or on the leaves to which masses of conidia adhere after the dead locust falls off. Brief notes are given of three other fungi parasitic on locusts in South Africa—viz., a green *Sporotrichum* in all probability identical with the Argentinian *S. paranense*, *S. globuliferum*, and *Fusarium acridiorum*.

605. Red Spider: Control. By E. A. McGregor. (*U.S. Dept. Agr., Farmers' Bull.* No. 831, 1934. From *Summ. of Curr. Lit.*, xv., **11**, 1935, p. 266.) A description is given of the red spider (*Tetranychus bimaculatus*) and the damage caused by it on cotton, especially in the south-east states of the U.S.A. Weeds and garden plants (*e.g.*, violets) that remain green during winter harbour the spider. Useful sprays include potassium sulphide, lime-sulphur, and paraffin oil emulsion.

606. Dos Informes Sobre el Arrebiatado, *Dysdercus ruficollis*. By J. Wille. (*Circ. Estac. exp. agric. Minist. Fom.*, No. 28, Lima, 1934. From *Rev. App. Ent.*, xxiii., Ser. A, **6**, 1935, p. 307.) An account of experiments and observations in 1934 in Peru to test del Busto's method of irrigating cotton plants as a measure against the cotton stainer, *Dysdercus ruficollis*, L. This practice appeared to destroy only a small percentage of the eggs and larvæ.

607. Les Quatorze Espèces de Tsé-Tsés du Congo Belge. By E. Hegh. (*Bull. Agr. du Congo Belge*, xxv., **4**, 1934, p. 628.) The fourteen species of tsetse fly dealt with are members of the *Palpalis*, *Morsitans*, *Fusca*, and *Brevipalpis* groups.

608. Arizona: Diseases of Field Crops. By J. G. Brown and R. B. Streets. (*Arizona Sta. Bull.* 148, 1934, p. 85. From *Exp. Sta. Rec.*, 72, **3**, 1935, p. 346.) A compact key to the diseases most prevalent in Arizona, including those affecting cotton, corn, and flax.

609. *Eremothecium ashbyii* Cotton Boll Fungus: Occurrence. By A. Guilliermond. (*C. r. Acad. Sci.*, 200, 1935, p. 1556. From *Summ. of Curr. Lit.*,

xv., **11**, 1935, p. 265.) A description is given of a new fungus, *Eremothecium ashbyii*, isolated from cotton bolls in the Sudan. It resembles the gametophytic form of *Spermophthora gossypii*, Ashby and Nowell.

[*Cf.* Abstrs. **595**, Vol. IV., and **419**, Vol. VI. of this Review.]

610. Cotton Gummosis and its Control. By N. G. Zaprometoff. (In Russian.) (*Fight for Cotton* (trans. title), Tashkent, 1934. From *Rev. App. Mycol.*, xiv., **5**, 1935, p. 304.) A very brief popular account of cotton gummosis (*Bacterium malvacearum*) based chiefly on Massey's work in the Sudan and Stoughton's researches on the organism in England. The disease is stated to occur wherever cotton is cultivated in the U.S.S.R., and to be fairly destructive in Central Asia, especially on Egyptian cottons, on which the blackarm form of the disease frequently causes losses up to 60 per cent. or more. While no cotton varieties have been found in Russia to be entirely immune from gummosis, recent data received from Transcaucasia would indicate that locally the " Kingkarayazski " No. 915 variety exhibits the greatest relative resistance. Experiments in 1929 showed that the incidence of the disease was reduced from 4·3 to 0·3 per cent. by applications of 300 kg. ammonium nitrate per hectare. Control measures, also based on work done abroad, are briefly discussed.

611. Résumé du Rapport sur l'Activité du Laboratoire de Phytopathologie (Stanleyville et Bambesa) en 1933 et la Campagne Cotonnière, 1933-34. By R. L. Steyaert. (*Bull. Agr. Congo Belge*, xxv., **3**, 1934, p. 376. From *Rev. App. Mycol.*, xiv., **4**, 1935, p. 223.) In an experiment conducted in the Belgian Congo in 1933, the bolls from four cotton plants in each of five plots sown at fortnightly intervals from July 10 were collected every week and the percentage amounts of internal boll disease (*Nemotospora coryli* and *N. gossypii*) and " red rot " present were calculated. The latter condition, which is not apparent externally, is a wet, later dry, garnet-red rot, probably of bacterial origin, generally affecting the whole segment; this dries up and the placenta becomes hypertrophied.

The data obtained showed that internal boll disease increased throughout the season, the figures for the five plots being, respectively, approximately 0·7, 0·3, 1·4, 2·4, and 6 per cent., whereas the amount of red rot present remained practically constant at approximately 1 per cent. in the first four plots, but jumped to 3 per cent. in plot 5. These figures refer to the total number of bolls on the plants, and include those in all stages of development, from the smallest to those about to open. Internal boll disease occurs in bolls 2·5 cm. in diameter, very occasionally in smaller ones, and never in those under 1·5 cm. in diameter.

Seedling damping-off, caused chiefly by *Rhizoctonia* (*Corticum*) *solani*, and to a very slight extent by *Sclerotium rolfsii*, was very severe, the percentage infection in the five plots and a later-sown one being, respectively, 7·5, 1·5, 11·7, 7·2, 7·2, and 4·5 per cent. An inverse correlation was established between intensity of infection and increasing soil temperature and sun heat.

In two localities young plants (with six to seven adult leaves) of the newly introduced Dixie Triumph cotton were attacked by angular leaf spot (*Bacterium malvacearum*) though Triumph Big Boll remained unaffected.

Cotton in the vicinity of Wamba-Ibambi developed a wilt (the symptoms of which are described), due probably either to *Fusarium vasinfectum* or *Verticillium albo-atrum*. Further investigations into this condition are in progress.

612. Cotton Root-Rot Investigations. (*U.S. Dpt. Agr. Bur. Chem. and Soils Rpt.*, 1934, p. 40. From *Exp. Sta. Rec.*, 72, **4**, 1935, p. 494.) Results of experiments on the relation of soil-fertility factors and the use of fertilizers to the control of cotton root-rot are briefly noted.

613. Relative Parasitism of the Cotton Root-Rot Organisms from Gujerat Soils. By V. N. Likhite and V. G. Kulkarni. (*Curr. Sci.*, iii., **6**, 1934, p. 252. From *Rev. App. Mycol.*, xiv., **6**, 1935, p. 359.) Of the three organisms which were found to stand in causal relationship to cotton root-rot in Baroda, the form of *Fusarium vasinfectum* isolated from "gorat" soils is stated to have been shown to be non-pathogenic to cotton, presumably owing to its having been exposed to the action of such soils for two consecutive generations, since a fresh strain of the fungus obtained from a locality where cotton wilt exists gave a high percentage of infection. There was also evidence that the presence of the Baroda form of *F. vasinfectum* in affected cotton plants was due to its general symbiotic association with nematodes. Observations (later confirmed by controlled experiments) in 1931-32 showed that in cotton sown in May and irrigated seven times with well water (with a pH value of 8) the percentage incidence of root rot associated with *Macrophomina* (*phaseoli*) and nematodes was 92, as compared with 28 to 58 per cent. in cotton sown during the monsoon season after the first showers; a study of the meteorological data for the period involved indicated that a soil moisture of 30 per cent. and a temperature of 40° C. favoured parasitism in *M. phaseoli* and nematodes jointly, but that as soon as these conditions disappear both organisms tend towards saprophytism in the soil.

614. Cotton Root-Rot Disease: Control in Texas. By G. T. Ratliffe. (*U.S. Dpt. Agr.*, *Tech. Bull.* No. 436, 1934. From *Summ. of Curr. Lit.*, xv., **11**, 1935, p. 265.) A report is given of observations made during a period of twenty-one years on the effects of crop rotations and methods of cultivation in the incidence of root-rot damage. Of all the numerous practices discussed, only four-year rotations had any definite effect in checking the disease.

615. Some Effects of *Phymatotrichum* Root-Rot on the Microscopic Characters of Cotton Fibres. By G. N. Stroman *et al.* (*Phytopathology*, xxv., **1**, 1935, p. 126. From *Rev. App. Mycol.*, xiv., **6**, 1935, p. 360.) The results (which are tabulated and discussed) of a microscopical examination of the fibres from Startex cotton plants killed by root-rot (*Phymatotrichum omnivorum*) in Texas in 1931 showed that those from individuals destroyed early in the season were abnormally wide and thick, with fewer convolutions per unit length than healthy material. The fibres from plants killed at a later stage of development did not differ appreciably from those of normal plants. The coarser, less twisted fibres from the plants killed in the early summer constituted less than 10 per cent. of the cotton harvested from plants grown under irrigation in the trials described, and would probably average not more than 20 per cent. of the crop from plants succumbing to root-rot under dry-farming conditions.

616. The Quality of Lint and Seed from Cotton Plants Infected with *Phymatotrichum* Root-Rot. By J. J. Taubenhaus and W. N. Ezekiel. (*Phytopathology*, xxv., **1**, 1935, p. 104. From *Rev. App. Mycol.*, xiv., **6**, 1935, p. 360.) Data are presented in tabular form and discussed, indicating that root-rot (*Phymatotrichum omnivorum*) appreciably affects the quality of lint and seed from Startex cotton plants in Texas, the damage being directly proportional to the earliness of the attack.

617. The Relation of Fertilizers to the Control of Cotton Root-Rot in Texas. By H. V. Jordan *et al.* (*U.S. Dpt. Agr.*, *Tech. Bull.* No. 426, 1934. From *Exp. Sta. Rec.*, 72, **4**, 1935, p. 494.) A progress report is presented of the results of field experiments on the relation of fertilizer usage to the control of *Phymatotrichum omnivorum* on cotton, conducted in the black-land prairie section of Texas during the period 1928-31. The tests were co-operative between the U.S.D.A. Bureau of Plant Industry, the Texas Experiment Station, and cotton-

growers. They covered the most prevalent soil types and climatic variations of the section.

Fertilizer analysis experiments, based on the triangle system, with applications of mixtures containing a total of 15 per cent. of plant food at the rate of 600 lb. per acre (in some instances 300 lb.), were carried out on eight or nine soil types, mostly for a period of two to four years in each case. Detailed results are presented.

In general, the greatest fertilizer response in acceleration of maturity and increased yield was secured from the combined application of nitrogen and phosphoric acid. Only in a few cases did nitrogen alone give greatest increase in yield. A few fields responded to phosphoric acid alone. There was little response to potash. An appreciable residual and cumulative effect of fertilizers was found.

Concentrated fertilizer materials, particularly the ammonium phosphates, showed marked effectiveness in accelerating early plant growth and maturity in certain seasons, but the results were not entirely consistent and did not demonstrate the anticipated advantages over ordinary commercial materials.

None of the common nitrogen carriers showed decided advantage over others tested. Marked increases in cotton yields were obtained following clean fallow on Wilson clay, which materially compensated for the loss of crop during the period of fallow.

Nitrogenous fertilizers applied after sorghum resulted in increased cotton yields sufficient to offset the unfavourable sorghum after-effects, and provide a further increase. Evidence shows the importance of acceleration of maturity usually effected by favourable fertilizers for evading losses due to progressive killing by root-rot. Field increases also usually more than compensate for the losses from the disease. A significant reduction in the proportion of cotton killed by root-rot was demonstrated where fertilizer treatments were effective.

In view of the results already obtained, the authors hold that there is a possibility that the cumulative effect of optimum fertilization, combined with crop rotation, fallowing, modified tillage, and other cultural treatments, may eventually lead to the eradication of the disease from fields so handled.

618. Observations sur la Stigmatomycose des Capsules du Cotonnier au Congo Belge. By R. L. Steyaert. (*Bull. Agr. du Congo Belge*, xxv., **4**, 1934, p. 473.) This disease has had an important effect in reducing the quality and value of lint in recent years. It has been known in the British West Indies since its description by Nowell in 1917, and is there carried by species of *Dysdercus*, *Nezara*, *Leptoglossus halteatus*, and *Phthia picta*, which have intermediate hosts, especially among the Leguminosæ. A long list of such hosts, and their distribution, is given. A detailed series of infection experiments was carried out, and showed that late-sown cotton was most affected. Three kinds of boll rot were found, two of which appear to be bacterial, while the third is due to a *Nematospora*. A list of literature is included. A paper that should not be neglected.

619. Investigations on Cotton Wilt. (*Arkansas Agr. Exp. Sta. Bull.* 312, 1934. From *Rev. App. Mycol.*, xiv., **4**, 1935, p. 221.) Preliminary experiments with detached portions of cotton plants resistant and susceptible to wilt (*Fusarium vasinfectum*) indicate that the character for resistance is not localized in the roots, but is found also in the aerial organs. The movement of the fungus through the vascular system is much more rapid in the stems of susceptible plants than in those of resistant ones, and the latter apparently contain a substance capable of inhibiting the growth of the pathogen in culture. The incidence of cotyledonary infection by *Bacterium malvacearum* on cotton seedlings was considerably reduced by early (end of April and beginning of May) seed treatments with

ceresan and new improved ceresan, but by mid-season no difference in the amount of angular leaf spot could be detected on the various plots.

620. Virus Diseases of East African Plants—I. By H. H. Storey. (*East Afr. Agr. Jour.*, Vol. I., No. 1, July, 1935, p. 63.) In this, the first of a series of articles, the author attempts to indicate the general outlook of the research work upon the problem; to show what is known of the nature of viruses; and thence to deduce the principles of the methods by which they may be controlled in agricultural crops.

GENERAL BOTANY, BREEDING, ETC.

621. Qualities in Cotton required by the Spinner. By N. S. Pearse. (*Text. Wkly.*, xv., 377, 1935, p. 555, and subsequent numbers.) A useful article which should be studied by growers and still more by breeders. Cultivators are recommended to grow longer rather than shorter staples, as having a better market. Uniformity of staple is the first desideratum, but fibre strength, absence of nep, good grade, careful ginning, and uniform baling are also essential. The question of price is discussed, and the author gives reasons for stating that "spinners prefer a steady market, or a steadily rising market."

622. Memoirs of the Cotton Research Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d., post free.) The ninth number of Series A, Genetics, has recently been issued, and contains the following papers reprinted from the *Journal of Genetics*:

Some New Interspecific Hybrids in the Genus *Gossypium* L. By A. Skovsted. Hybridization experiments have been carried out between the following groups with the exception of (*h*) and (*i*): (*a*) *G. aridum* (*Erioxylum*); (*b*) *G. armourianum*; (*c*) *G. Davidsonii*; (*d*) *G. tribolum*; (*e*) *G. Sturtii*; (*f*) *G. Stocksii*; (*g*) *G. anomalum*; (*h*) Asiatic cottons; and (*i*) New World cottons.

Of the 35 possible combinations, one has not been tried and 6 have so far been unsuccessful. The results include empty seeds (9 combinations), hybrids dying in the cotyledon stage (3 combinations), and partly fertile hybrids (4 combinations), and sterile hybrids (12 combinations). These are summarized in Diagram 1.

Within the species with 13 chromosomes, Asiatic cottons, *G. anomalum* and *G. Stocksii* form one group, and *G. armourianum* and *G. aridum* another, *G. tribolum* probably occupying an intermediate position. Apparently *G. Davidsonii* and *G. Sturtii* represent two separate side-groups.

Hybrids between New World cottons ($n=26$) and the species with $n=13$ are usually much easier to produce than hybrids between the species with $n=13$. So far, only three of the hybrids from the present study have been sufficiently fertile to afford material of use to the practical plant-breeder. These all have $2n=39$, the parental species being New World cottons ($n=26$) and the wild species *G. aridum*, *G. armourianum* and *G. tribolum* with $n=13$ from America.

A haploid, *G. Davidsonii*, was obtained in hybridization experiments with *G. tribolum*.

Further reasons for the inclusion of the genera *Thurberia* and *Erioxylum* in the genus *Gossypium* have been advanced. On cytological, genetical, and morphological grounds it is considered that all the species and groups mentioned form a natural genus.

Cytological Studies in Cotton—Pt. III.: "A Hybrid between *Gossypium Davidsonii* Kell. and *G. Sturtii* F. Muell." By A. Skovsted. *Gossypium Davidsonii* ($n=13$), a wild species from California, has smaller chromosomes than

G. Sturtii ($n=13$), a wild species from Australia. This difference in chromosome size is maintained in the hybrid, and enables a distinction between the paternal and the maternal chromosomes to be made.

The chromosome pairing in the hybrid is incomplete, but allosyndesis takes place about nine times more often than autosyndesis. Univalents are just as frequent between the small chromosomes from *G. Davidsonii* as between the larger chromosomes from *G. Sturtii*.

The chiasma frequency is the same in the pure species despite the difference in chromosome size. Contrasted with the pure species, the chiasma frequency in the hybrid is significantly smaller in the bivalents containing a *Davidsonii* and a *Sturtii* chromosome.

The difference in the size of the chromosomes of the species under observation is in all probability neither the result of genetic factors, nor associated with a difference in pairing blocks.

623. Memoirs of the Cotton Research Station, Trinidad. (Pubd. by the Empire Cotton Growing Corporation, price 2s. 6d., post free.) The tenth number of Series A, Genetics, has recently been issued, and contains the following papers reprinted from the *Journal of Genetics*:

The Genetics of Cotton—Pt. XII.: "Homologous Genes for Anthocyanin Pigmentation in New and Old World Cotton." By S. C. Harland. Transference of the gene *R* from *G. arboreum* L. with $n=13$ chromosomes to *G. hirsutum* L. with $n=26$ chromosomes, was successfully carried out by means of several back-crosses, in the course of which the initial great sterility was ultimately modified to complete fertility.

In the *arboreum* genotype *R* produced the character complex red plant body, red flower, and intense petal spot. In the *hirsutum* genotype the phenotypic effect of *R* involved a great reduction in the intensity of red coloration in the plant body and in the flower, and a total disappearance of the petal spot.

It is considered that in the Asiatic group of Gossypiums *R* is accompanied by a constellation of modifiers, the combined effect of which is to enhance the manifestation of anthocyanin pigmentation, while the New World *G. hirsutum* either lacks such modifiers altogether or carries a neutralizing or diluting set of modifiers in the other 13-chromosome sub-genom.

The *R* already established to be a member of a multiple allelomorphic series of factors conditioning anthocyanin pigmentation in the Asiatic group is most probably a new allelomorph in a similar multiple allelomorphic series characterizing the New World group. The theory of Skovsted (1934) that the New World $n=26$ group is amphidiploid with one sub-genom homologous with the $n=12$ Asiatic species *G. arboreum* and *G. herbaceum* is thus strengthened by genetic evidence.

From the present geographical distribution of the Asiatic and New World groups, it is suggested that the New World amphidiploids arose during late Cretaceous or early Tertiary times.

The Genetics of Cotton—Pt. XIII.: "A Third Series of Experiments with the Crinkled Dwarf Mutant of *G. barbadense* L. The Cross *barbadense* crinkled × *hirsutum* crinkled." By S. C. Harland. The cross between *hirsutum* crinkled (Type 9) and *barbadense* crinkled gave in F_2 a series of crinkleds ranging from an extreme and exaggerated type of crinkled (super-crinkled) to a type phenotypically indistinguishable from normal (pseudo-normal). In later generations several new types of crinkled were extracted in homozygous form.

It is considered that *G. barbadense* and *G. hirsutum* possess dissimilar modifier complexes, which in the interspecific cross are broken down, leading to the production of a varying series of genotypical backgrounds upon which the crinkled

mutant manifests itself in a corresponding series of reactions, some favourably and others unfavourably.

The conversion of the crinkled mutant to pseudo-normal by genic recombination resulting from the interaction of *barbadense* and *hirsutum* modifiers favours Fisher's view that recessives may ultimately become merged in the wild type by accumulating modifiers.

A new method for the production of duplicate genes is suggested.

THE GENETICS OF COTTON—Pt. XIV.: "The Inheritance of Brown Lint in New World Cottons." By S. C. Harland. The inter-*barbadense* cross Egyptian brown × Sea Island white gave F_1 intermediate and complicated segregation of the blending type in F_2. This was demonstrated to be due to the fact that the factor K^B of the brown parent was accompanied by a number of plus modifiers absent in the white parent.

Repeated back-crossing of heterozygotes to the brown parent had the effect of equalizing the plus modifiers of both the dominant and recessive phases of the factor K^B. Selfing after three back-crosses gave simple segregation in 3 brown: 1 light brown.

A negative correlation was shown to exist between lint colour and lint length, the factor K^B or a factor closely linked to it conditioning a shortening in the lint length of approximately 5·1 mm. in the homozygous phase and 2·7 mm. in the heterozygous phase.

Minor colour factors were also correlated with variations in lint length.

The blending type of inheritance of brown lint in Egyptian × Sea Island is considered to be due to the disintegration by human agency of an original brown-lint factor complex.

The cross of brown *barbadense* × brown *hirsutum* was found to involve duplicate genes for lint colour. The distribution of the known pairs of duplicate genes in *G. barbadense* and *G. hirsutum* is discussed.

624. GENETICS SINCE 1910. By J. B. S. Haldane. (*Nature*, 135, 1935, p. 726. From *Pl. Bre. Absts.*, v., **4**, 1935, p. 277.) A summarized statement of the numerous achievements and solved and unsolved problems of genetics, and its applications to plants and animals (including man), and also to evolution and the origin of species.

625. GENETICAL AND CYTOLOGICAL STUDY OF SPECIES HYBRIDS OF ASIATIC AND AMERICAN COTTONS. By C. F. Feng. (*Bot. Gaz.*, 96, 1935, p. 485. From *Pl. Bre. Absts.*, v. **4**, 1935, p. 341.) Two Asiatic species, *G. arboreum* L. var. *neglecta* Watt and *G. nanking* Meyen, and two American species, *G. barbadense* and *G. hirsutum*, were used in reciprocal crosses to test the compatibility between Asiatic and American species. Hybrid plants were obtained only from *G. hirsutum* × *G. nanking* and its reciprocal; but the available data were insufficient to determine the difference in compatibility between different species. The results, however, tended to agree with the general observation that crosses in which the ♀ parent has the higher chromosome number are more successful.

Data from pollinations of American plants by Asiatic pollen seemed to suggest that the low percentage of hybrids between Asiatic and American species was not due to retarded pollen tube growth, but probably to some incompatibility of the gametes.

Three hybrid plants, A, B, and C, exceeded their parents in height, number and length of nodes and basal circumference of the stem, and the superior vigour of one hybrid as compared with the others suggested that reciprocal crosses may differ in the degree of hybrid vigour.

The behaviour of a number of morphological characteristics in crosses between varieties of *G. nanking* and *G. hirsutum* was examined in six other F_1 hybrids,

and evidence was obtained that reciprocal crosses give the same results even in crosses between species from different groups. These plants, which showed a mixture of Asiatic, American, and intermediate characters, were sterile. The three hybrids A, B, and C also proved self-sterile.

In the hybrids the pollen was very irregular in size, rarely burst in water, and was mostly abortive, like the ovules.

626. GENETIC RELATIONS OF THREE GENES FOR ANTHER COLOUR IN COTTON. By G. N. Stroman. (*J. Amer. Soc. Agron.*, 27, **3**, 1935.) Data are presented on anther colour in cotton which appear to verify the hypothesis that there are two basic genes, *P* and *B*, for yellow and white anthers, with an additional gene, *I*, which when present inhibits either *P* or *B* when either is alone. The interrelations of these three genes are shown by the several ratios of yellow to white, namely, 42 : 22, 3 : 1, 9 : 7, 13 : 3, 15 : 1, 1 : 3, and 3 : 13. Such ratios should not be uncommon in cotton, owing to the large number of pairs of chromosomes found in the New World cottons.

627. NUCLEAR STRUCTURE AND CHROMOSOMES. By R. R. Gates. (*Nature*, 135, 1935, p. 729. From *Pl. Bre. Absts.*, v., **4**, 1935, p. 278.) A review of progress since the King's accession.

628. EL MEJORAMIENTO DE LA VARIEDAD TANGÜIS. By T. B. Barducci. (*Bol. Minist. Fom. Lima*, **6**, 1934. From *Pl. Bre. Absts.*, v., **4**, 1935, p. 339.) The production of the variety is traced, starting with the initiation in 1905 of selection for wilt resistance, in the variety Suave (degenerated Upland) by Dom Fermin Tanguis. By 1930 the variety Tanguis so produced occupied 91 per cent. of the total area of cotton in Peru. The characteristics of the variety, which combines wilt resistance with other high qualities, agronomic and industrial, are described. The plant from which the new variety arose segregated sharply into two types, one resistant, and the other susceptible, and the author is of the opinion that it arose by mutation, and that the plant originally selected was a hybrid between the original mutant and the common Suave, in a field of which it appeared. The comparatively short space of time which was required for its purification indicates that the original plant had mutated in a small number of characters, but all of them in a favourable direction.

629. NOTES ON COTTON-BREEDING IN UGANDA. By G. W. Nye. (*East Afr. Agr. Jour.*, Vol. I., No. 1, July, 1935, p. 44.) A brief summary of the history of cotton in Uganda is given. The main problems confronting the industry are stabilization of the crop in the western area to produce a uniform product, and at the same time improve the staple length, which has deteriorated. In the eastern area the quality of the Nyasaland types is fairly satisfactory, but the yield is poor. The same staple as the western area is required here ($1\frac{3}{16}$ inches), but owing to the difficulties of climate and soil this length is not easy to obtain. A brief account is given of the methods in use to tackle these problems, and to obtain varieties of cotton resistant to jassid and other pests and to blackarm and wilt diseases. Several very promising strains have been evolved as the result of selection work, namely, S. G. 29, S.P. 56, S.P. 86, S.G. 23. 8, B.P. 50, B.P. 52, and B. 31.

630. TANGANYIKA: COTTON SELECTION AND ROTATION OF SUPPLY OF IMPROVED COTTON SEED. By N. V. Rounce. (*East Afr. Agr. Jour.*, Vol. I., No. 1, July, 1935, p. 35.) The following plan is suggested as one which could be followed in Tanganyika in a selection and seed supply scheme, varying under different conditions in respect of the yield obtained and areas of isolation in which seed can be multiplied on a big scale. *First year:* Single plant selections. *Second year:* Progeny plots of each single plant selection which has passed a lint length test. A number of plants are selfed in each plot. *Third year:* Strain trial of

selfed seed of best progeny plots which pass lint, seed and ginning percentage tests, and are outstanding in field characters. *Fourth year:* Strain trial of superior strains of previous year, together with new strains in first year of trial. Half to one acre multiplication plots planted in isolation. *Fifth year:* Strain trial for third and last year. Twenty- to forty-acre multiplication plots planted in isolation. *Sixth year:* 300 to 600 acres of multiplication farm planted up with selected strain. *Seventh year:* Resultant seed planted by natives in a gazetted area served by a ginnery or ginneries which buy only this cotton. All seed cotton purchased and ginned in strict isolation. *Eighth year:* Seed distributed to farmers over the whole area intended to be supplied.

FIBRE, YARN, SPINNING, WEAVING, ETC.

631. The Analysis of Variance Method of Measuring Differences between Staple-Length Designations of Press-box and Cut Samples of Cotton. By F. H. Harper and W. B. Lanham. (*U.S. Dpt. Agr. Bur. Agr. Econ.*, **1933**. From *Exp. Sta. Rec.*, 72, **3**, 1935, p. 321.) The average of staple-length designations of samples cut from cotton bales slightly exceeded that of staple length designations of samples taken from the gin press-box. Differences between staple length designations of press-box and cut samples from the same bales were very inconsistent, but at least a part of such inconsistency might be accounted for by the element of tolerance. Inconsistency of differences in staple length distribution with either group of samples as the base was so great that variability contributing to bias or difference, on the whole, between the two series of staple-length observations was negligible compared with variability associated with inconsistency in staple length designations. Discussions on the measurement of average differences in two series of observations and on the analysis of variability in replicate observations are appended.

632. Cotton: Quality Determination. By E. Wagner. (*Leipz. Monats. Text. Ind.*, **50**, 2-3, 26-27, 50-52, 1935. Abstr. from *Summ. of Curr. Lit.*, xv., **9**, 1935, p. 232.) The determination of the quality of cotton in samples of yarns or fabrics which are to be reproduced involves determinations of the maximum and mean fibre length, the regularity of staple and the number of fibres in the yarn cross-sections. Strength, twist and similar determinations give valuable additional information, but are not always possible. Staple diagrams obtained for a range of standard cotton yarns spun from different qualities of cotton are useful for comparison purposes. Typical staple diagrams and frequency charts are shown.

633. Cotton: Drafting. By R. P. Richardson. (*Ind. Text. Jour.*, **45**, **1935**, p. 208. From *Summ. of Curr. Lit.*, xv., **11**, 1935, p. 269.) The influence of fibre factors such as grader's length, mean length, modal length, effective length, weight, strength, elasticity, maturity and clinging power, and of process factors, such as doubling, roller setting, fibre number, twist, draft, speed and humidity in the drafting of cotton, is discussed. The differences between hand-spinning and roller drafting processes are pointed out, and some quantitative data for 30's and 80's yarns are given. The conclusion is drawn that much of the "draftability" of a cotton depends on the regularity of its fibre properties, especially length, coupled with the quality of the drafting applied.

634. Photo-electric Method for Determining the Fibre Length Distribution in Cotton. By O. A. Pope. (*46th Ann. Rpt. Agr. Exp. Sta., Arkansas*, 1934, p. 27.) A direct reading method adapted for use on combed fibre attached to the seed is discussed. A distinct advantage of this method is found in the fact that the data from any desired number of seeds may be composite and

analyzed as one sample. A comparison of the results of the photo-electric method with those obtained by the sorter method shows good agreement both in the characteristic of the distribution curves and in the calculated mean values. In representative frequency curves, the agreement between the photo-electric method and the sorter method usually checks as closely as duplicate sorter curves, indicating that the results are directly comparable with those obtained by the sorter method. There is, however, a wide difference in time required for making a determination. With the photo-electric method the fibre on a seed may be prepared for the test and the readings completed in from two to three minutes, in contrast to the much longer time required with the sorter.

635. Breeding for Fibre Length Regularity in Cotton. By G. N. Stroman. (*J. Amer. Soc. Agron.*, 26, **12**, 1934.) Work at the New Mexico Agricultural Experiment Station on fibre regularity is reported. Summary data on four principal strains that are high as regards percentage of $1\frac{1}{8}$-plus fibres are given. Percentage of $1\frac{1}{8}$-plus fibres is the percentage of cotton of $1\frac{3}{8}$, $1\frac{1}{4}$, and $1\frac{1}{8}$ inches in a sample that has been pulled from a cotton fibre sorter. In preparation for the sorter, ten seeds are taken, each from different bolls, and carefully combed. They are then placed in the sorter and the different lengths separated, and each length weighed on a milligram balance. The four principal families as reported show that some progress has been made in the matter of breeding for high percentage of $1\frac{1}{8}$-plus fibres. This is evident when they are compared with a strain with a low percentage of $1\frac{1}{8}$-plus fibre, and when compared with the check rows planted to a highly bred strain of cotton.

636. Improving the Uniformity of Cotton Fibre by the Use of the Pressley Sorter. By E. H. Pressley. (*Tech. Bull.* No. 54, Agr. Exp. Sta., Arizona, 1934. From *Pl. Bre. Absts.*, v., **4**, 1935, p. 340.) Though lint yield must be the main consideration of the cotton-breeder, uniformity of lint should also be considered. Having examined the environmental factors affecting uniformity of lint, the Pressley sorter, and its use and application to the problem of testing this character in individual plants selected for breeding purposes, are described in full.

Selection in 1931-33 with the aid of the sorter led to the entire elimination of four of the original nine families of cotton used—a fact which suggests that there may be heritable variation in the uniformity of lint, and that by the method described more uniform strains might be established. It is, moreover, of interest that the technique when applied to the selection of plants with a high lint index or weight of lint per 100 seeds also resulted in an improvement. The process is recommended as saving both time and labour.

[*Cf.* Abstr. **148**, Vol. XI. of this Review.]

637. Textile Fibres: Importance of Structure for Finishing Processes. By — Haller. (*Textilber.*, xvi., 1935, pp. 110 and 185. From *Summ. of Curr. Lit.*, xv., **9**, 1935, p. 232.) A review of the structure of cotton, wool, silk and bast fibres, the effect of various treatments on structure, the importance of fibre structure in mercerizing, bleaching, dyeing and finishing operations, and the influence of structure on strength, resistance at creasing and other properties.

638. Textile Fibres: Strength. (*Textilber.*, **16**, 1935, p. 200. From *Summ. of Curr. Lit.*, xv., **9**, 1935, p. 232.) Dry and wet strengths in gm. per denier are given for American, Egyptian and Sakellaridis cottons, wool, and viscose, cellulose acetate and cuprammonium rayon staple fibres.

639. Practical Use of the Titer Control of Textile Fibres. By V. Ettore. (*Atti. Congr. naz. Chim.*, **4**, 1933. From *J. of Text. Inst.*, xxv., **6**, 1935, A316.)

Discusses the application of the author's methods to the examination of defective fibres.

640. Cotton Hair: Micro-structure. By G. G. Osborne. (*Text. Res.*, **5**, 1935, pp. 275 and 307. From *Summ. of Curr. Lit.*, xv., **11**, 1935, p. 280.) A detailed micro-analysis of the structure of the cotton hair has been made and descriptions are given of the structure of the cuticle, primary wall, secondary wall, and lumen. The molecular arrangement, growth mechanism, and intermicellar structure of the hair are discussed in detail. The author suggests that the formation of the fibrillæ is due to protoplasmic streaming along fairly definitely oriented channels on the cell wall, in contradistinction to small, less definite areas where streaming is irregular. In the regular flow-beds the cellulose deposit units would assume an oriented and concentrated arrangement, whilst in the random streaming regions they would be scantily deposited and in irregular order.

641. Testing for Moisture Content in Cotton or Yarn. (*Int. Cott. Bull.*, xiii., **51**, 1935, p. 377.) A new device has now been developed by means of which the moisture content of a bale, hank, cop, cheese, cone or any other yarn package, and also cloth, can be tested in a few seconds. This is a portable instrument called the Electro-Psycrometer, which can be operated by any member of a mill staff after one demonstration. The device is electrically controlled from the mains, one of its greatest advantages being that it is suitable for both alternating and direct current of any voltage between 120 and 240. The method of application is extremely simple. To ascertain the moisture content of any type of yarn package, the cop, cheese, or whatever form it may take, is held in one hand, whilst the needles of the hand-grip are thrust into the yarn. The needle of a large quadrant on the instrument will then register a certain number which, when compared with the correct chart (complete sets of charts for all textile fibres are supplied), gives the percentage of moisture content. A slightly longer set of needles is used for testing bales or large packages.

A useful feature of the device is the fact that the reading is not confined to the actual point of contact of the needles and the material, but is through a field in the vicinity of the needles. By placing the needles into the material at several different points the average moisture content of the package can be obtained.

The instrument is guaranteed by the makers for all time to within 0·2 per cent. accuracy; actual tests compared with conditioning tests show, however, that results with the new device are rarely more than 0·05 per cent. different. The sole British agents for the instrument are G. W. Thornton and Son, 5, Blackfriars Street, Manchester.

642. Immature Cotton Hairs: Classification by Polarization Microscope. By E. R. Schwarz and G. H. Hotte. (*Text. Res.*, **5**, 1935, p. 370. From *Summ. of Curr. Lit.*, xv., **14**, 1935, p. 366.) Certain data are presented in support of the method proposed by Pattee for the determination of the degree of maturity of a sample of cotton by means of polarized light. It is also shown that the fibres selected by means of their characteristic behaviour in the polarizing microscope have cross-sections that are definitely separable by measurements and appearance into distinct groups.

[*Cf.* Abs. **309** of this Review.]

643. Cotton Yarn: Irregularity Testing; Statistical Treatment. By L. H. C. Tippett. (*Text. Mfr.*, **61**, 1935, p. 49. From *J. of Text. Inst.*, xxvi., **6**, 1935, A317.) Report of a lecture to statisticians, discussing the statistical problems involved in yarn testing.

644. A New Cotton Yarn. (*Int. Cott. Bull.*, xiii., **51**, 1935, p. 373.) Interest in cotton-spinning circles has been aroused by the announcement made by John

Dugdale and Sons, Ltd., of Blackburn, that they have discovered a new process for making cotton yarns with a silk-like lustre, a really soft and pleasing "feel," and which can be woven as weft on ordinary looms without difficulty. In addition the woven fabric can be treated without detriment to any of the usual finishing processes, and can be retailed at a price comparable with that of a similar fabric woven from ordinary cotton yarns.

645. COTTON CORD FOR TYRES. (*Crown Colonist*, June, 1935, p. 275.) The use of cord in cycle and motor tyres has led to a very large use of cotton. To-day the tyre industry ranks amongst the most important users of cotton, and it is estimated that over 500,000 bales, or 250 million pounds, of cotton are used annually in the manufacture of tyres.

TRADE, CO-OPERATION, ETC.

646. COTTON GOES TO MARKET. By Alston H. Garside. (Pubd. by Fredk. A. Stokes Co., New York, price $3.50. From *Text. Wkly.*, xv., **377**, 1935, p. 565.) From this review we quote the following: "It gives a broad picture of the marketing of American cotton which should satisfy not only the actual trader or producer concerned with cotton as a business, but also that large circle of general readers who read more for information than for pleasure. . . . The book is international in its scope . . . and is well illustrated."

647. A NEW COTTON FUTURES CONTRACT. (*Int. Cott. Bull.*, xiii., **51**, 1935, p. 418.) The Liverpool Cotton Association has adopted in principle a new futures contract called No. 1, which will be based on the principal "outside" growths of the raw material, such as Brazilian, Peruvian, Argentine, and African. The Association has at present futures contracts for American, Egyptian (Sakel and Uppers), Indian, and Empire. A further new contract has become advisable owing to the increased use of "outside" growths. The actual terms of the contract remain to be settled and may present difficulties, and it will be some time before the new contract is in actual use.

648. THE PRICE OF SILVER AS A GUIDE TO TRADE PROSPECTS. By E. E. Canney. (*Text. Wkly.*, xv., **377**, 1935, p. 566.) A long discussion, in which the position is maintained that the gold price of silver must rise very much more to put trade on a proper footing.

MISCELLANEOUS.

649. THE INTERNATIONAL COTTON CONFERENCE, 1935. (*Text. Rec.*, May, 1935, p. 26.) The Seventeenth International Cotton Congress was held in Milan and Rome from April 29 to May 4. Every sphere of activity and all aspects of the current cotton situation were discussed, and among the important papers read at the Conference may be mentioned the following: "Silver and the Cotton Industry" (Master Cotton Spinners' Federation); "The Production and Marketing of Cotton" (Youssef Bey Nahas); "The Position of American Cotton" (C. T. Revero); "Jute Fibres in Cotton" (W. L. Balls); "The European Cotton Industry" (Otto Bankwitz); "Textile Machinery Progress" (Nasmith and English).

650. SCIENCE OF THE YEAR 1934: THE BIOLOGICAL SCIENCES. By W. B. Brierley. (Reprint received from the author.) A valuable but very condensed review of the work carried out during the year, and the important results obtained in connection with Human Evolution, Cytogenetics, Zoology, General Physiology, Botany, Microbiology, and Disease. A feature of the year was the Russian work in applied botany, and especially the origin and distribution of crop plants.

Important advances were made in research on animal and plant viruses, and a vast amount of work was done in animal pathology, many valuable books being published. The author writes in conclusion: "Perhaps the most striking characteristics of the intellectual climate of 1934 were a tendency to question the adequacy of accepted biological philosophy, and a recognition of the fact that science has social roots and social consequences, and cannot develop independently of social values."

651. THE IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY. In the 27th Ann. Rpt. of the Governing Body for the year ending July 31, 1934, it is stated that the educational work of the College during the year proceeded satisfactorily on established lines with little change. The total number of students registered was 1,074, or 83 less than the previous year. On the results of the research work at the College 78 higher degrees of the University of London were awarded, and 131 higher diplomas of the Imperial College, a total of 209 compared with 212 for the preceding year. Many important matters were considered during the year, including: revised regulations governing the award of Entrance Scholarships; the admission of special classes of students to courses in Technical Optics leading to the Diploma of Membership of the Imperial College; a modification of Timetables for Royal College of Science and Royal School of Mines first-year students; the award of the Diploma of the Imperial College in Statistics. An outstanding matter in connection with the provision of buildings for the expanding activities of the College was the acquisition during the year of the building of the Royal School of Needlework. In connection with the Appointments Board, of the total of 252 appointments secured, 101 were obtained through the efforts of the Board, and 151 on the initiative of the registered individuals. The outlook is definitely better than it has been for several years.

ERRATUM.

DRAINAGE IN THE SUDAN GEZIRA. By H. Greene and M. A. Bailey. Vol. XII., No. 3, p. 212, line 47: For "£E.0.40" read "£E.40."

PERSONAL NOTES

OFFICERS ON LEAVE.

When an officer of a colonial Department of Agriculture (or of the allied departments of Irrigation, Transport, etc.) comes "home" on leave, he usually brings with him much information that may be of considerable value to similar officers in other colonies, or to the officers of the Empire Cotton Growing Corporation, who have to collect, collate, and use all possible information relating to cotton. The Corporation would consequently much appreciate the courtesy if Directors of Agriculture and others would be so kind as to inform them, in advance if possible, of the names, probable addresses, and approximate dates of arrival in England of officers coming on leave. This would give the Corporation the opportunity of getting into touch with these officers themselves, and of giving the latter the opportunity of meeting with one another. A further courtesy would be conferred if the officers themselves, upon arrival, would call at, or inform, the offices of the Empire Cotton Growing Corporation, which are on the Fourth Floor of King's Buildings, Dean Stanley Street, Millbank, S.W. 1.

At the date of writing the following officers are on leave, or will shortly be arriving in England from cotton-growing countries:

Ceylon	Mr. R. R. Follett.
,, ...	Mr. A. W. R. Joachim.
,, ...	Mr. W. C. Lester Smith.
Cyprus	Mr. H. M. Blunt.
Gambia	Mr. F. W. Hall.
Gold Coast	Mr. G. G. Auchinleck.
,, ,, ...	Mr. M. Greenwood.
,, ,, ...	Mr. C. W. Lynn.
India	Mr. J. B. Hutchinson.
Kenya Colony	Mr. J. E. P. Booth.
,, ...	Mr. J. R. MacQueen.
Nigeria	Mr. H. C. Doyne.
,, ...	Mr. H. Roebuck.
,, ...	Mr. D. B. Sabiston.
,, ...	Mr. J. W. Wallace.
,, ...	Mr. A. H. Young.
Nyasaland	Mr. C. Smee.
Northern Rhodesia	Mr. R. H. Fraser.
Sierra Leone	Mr. E. S. Garner.
Tanganyika Territory	Mr. L. R. Doughty.
,, ,, ...	Mr. W. V. Harris.
,, ,, ...	Mr. B. J. Hartley.
,, ,, ...	Mr. R. D. Linton.
,, ,, ...	Mr. F. R. Sanders.
Uganda	Mr. C. E. J. Biggs.
,, ...	Mr. C. W. L. Fishlock.
,, ...	Mr. C. J. Hansford.
,, ...	Mr. G. H. E. Hopkins.
,, ...	Dr. W. S. Martin.
,, ...	Mr. G. W. Nye.
West Indies	Mr. F. M. Bain.
,, ...	Mr. A. C. Barnes.
,, ...	Mr. R. W. R. Miller.
Zanzibar	Mr. L. W. Raymond.

The following officers of the Corporation's staff abroad are also on leave in this country:

Nigeria	Mr. G. Browne.
Northern Rhodesia	Mr. A. G. Bebbington.
South Africa	Mr. D. MacDonald.
Sudan	Dr. H. Greene.
,, ...	Mr. T. Trought.
West Indies	Dr. T. G. Mason.
,, ,, ...	Mr. R. A. Silow.

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